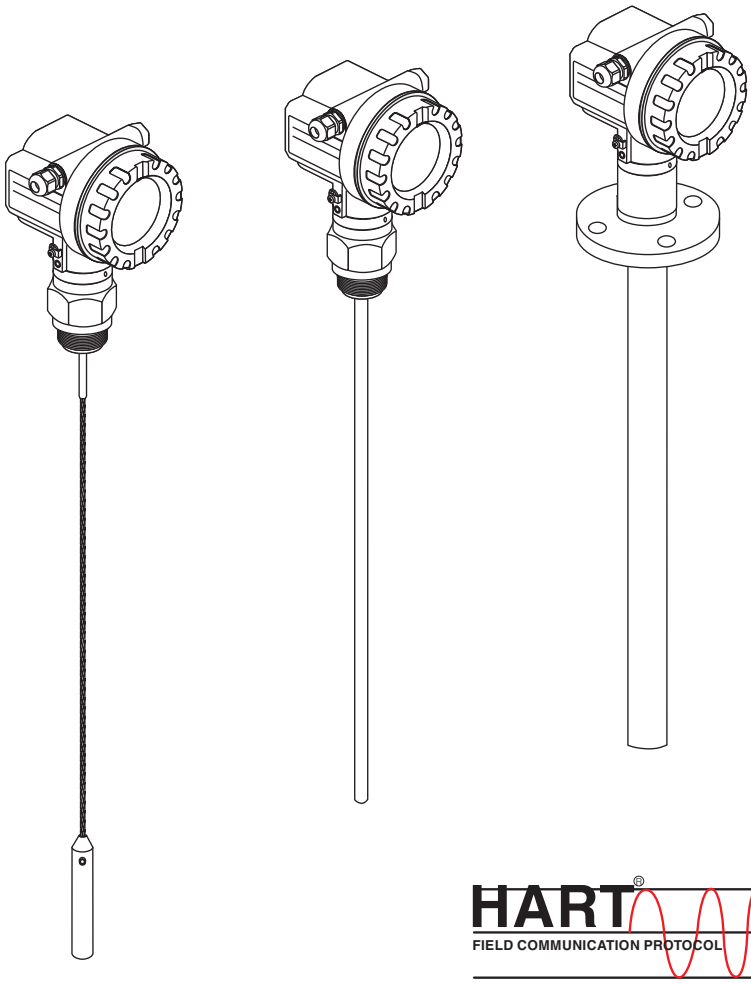
BA 242F/00/en/02.03
Nr. 52011930

Valid as of software version:
V 01.02.00 (amplifier)
V 01.02.00 (communication)

levelflex M
FMP 40
HART/4...20 mA
Guided Level-Radar

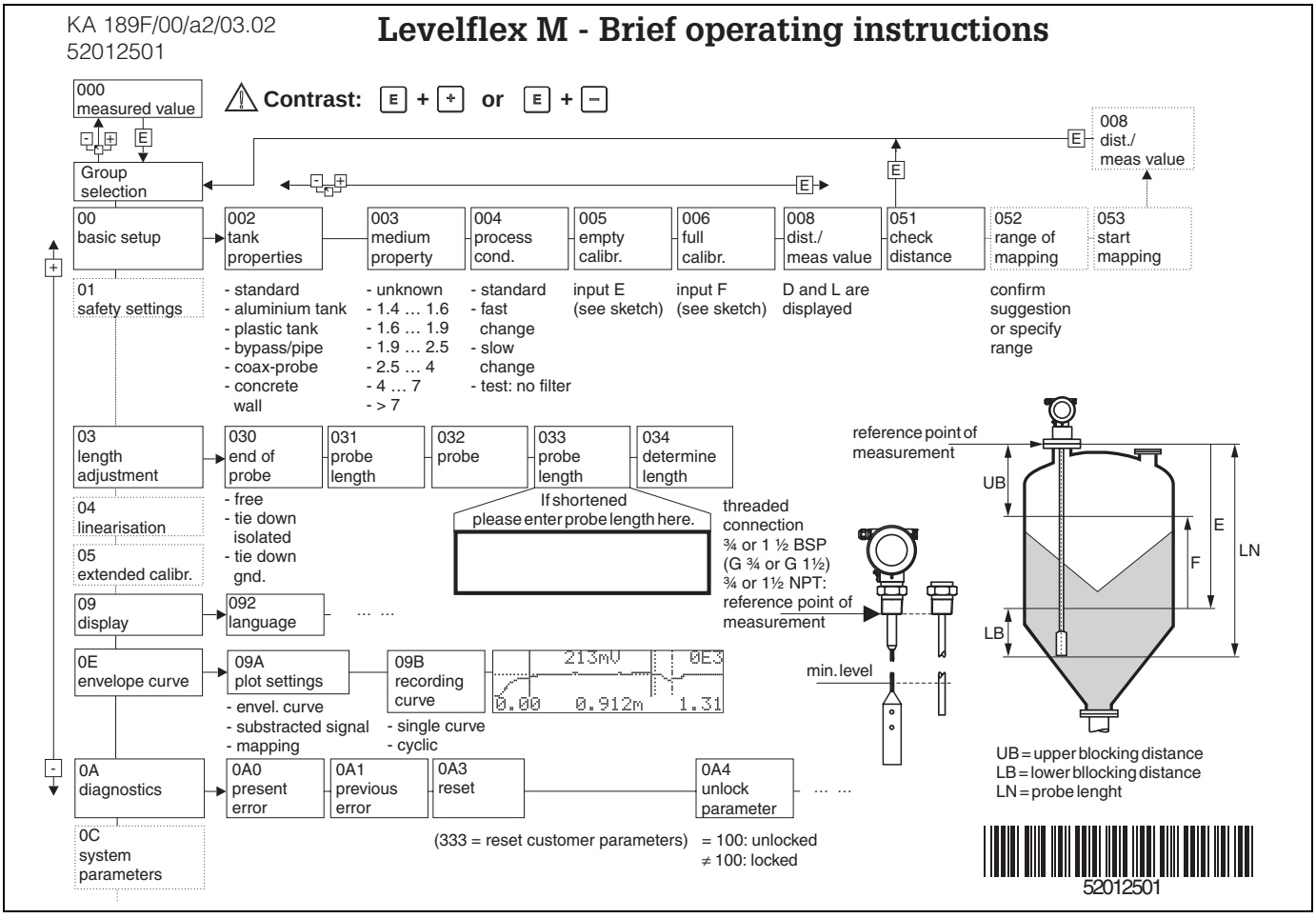
Operating Instructions



HART®
FIELD COMMUNICATION PROTOCOL

Endress+Hauser
The Power of Know How

Brief operating instructions



Note!
This operating manual explains the installation and initial start-up for the level transmitter measuring device. All functions that are required for a typical measuring task are taken into account here.
In addition, the Levelflex M provides many other functions that are not included in this operating manual, such as optimising the measuring point and converting the measured values.

An **overview of all device functions** can be found on Page 84.

The operating manual BA 245F/00/en provides an **extensive description of all device functions** – Description of the device functions for Levelflex M, which can also be found on the enclosed CD-ROM.

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1 Safety instructions

1.1 Designated use

The Levelflex M FMP 40 is a compact level transmitter for the continuous measurement of solids and liquids, measuring prinziple: Guided Level Radar / TDR: **T**ime **D**omain **R**eflectometry).

1.2 Installation, commissioning and operation

The Levelflex M has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

1.3 Operational safety

Hazardous areas
Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an *integral part* of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.
- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.

1.4 Notes on safety conventions and symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Safety conventions

Symbol	Meaning
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned

Explosion protection

	**Device certified for use in explosion hazardous area** If the Levelflex has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. – Devices located in and wiring entering areas with the designation "explosion hazardous areas" must conform with the stated type of protection
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. – Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas.

Electrical symbols

	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

2 Identification

2.1 Device designation

2.1.1 Nameplate

The following technical data are given on the instrument nameplate:

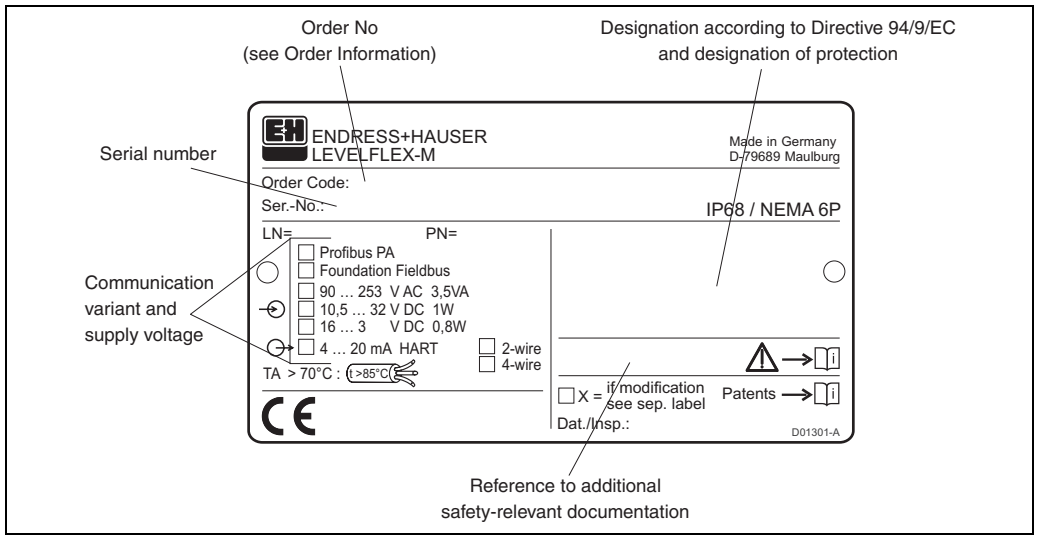


Fig. 1 Information on the nameplate of the Levelflex M FMP 40 (example)

2.1.2 Ordering structure

Ordering structure Levelflex M FMP 40

10	**Certificates**		
	A	For non-hazardous areas	
	M	FM	DIP, Class II, Division 1, Group E-G N.I.
	N	CSA	General Purpose
	P	CSA	DIP, Class II, Division 1, Group G+coal dust, N.I.
	S	FM	IS - Class I/II/III, Division 1, Group A-G N.I.
	T	FM	XP - Class I/II/III, Division 1, Group A-G
	U	CSA	IS - Class I/II/III, Division 1, Group A-D, G+coal dust, N.I.
	V	CSA	XP - Class I/II/III, Division 1, Group A-D, G+coal dust, N.I.
	1	ATEX II 1/2 G	EEx ia IIC T6
	2	ATEX II 1/2 D	Alu cover, dust Ex
	3	ATEX II 2 G	EEx em [ia] IIC T6
	4	ATEX II 1/3 D	transp. cover, dust Ex
	5	ATEX II 1/2 G, II 1/3 D	EEx ia IIC T6
	Y	Special version	

20		**Probe version, material 1)**		
			Type / application	*Material*
		A	4 mm rope probe, predominantly bulk solids	316
		B	6 mm rope probe, solids	316
		K	One rod probe 16 mm, predominantly liquids	316L
		L	Coax probe, liquids	316L
		N	Rod probe 6 mm, liquids	316L
		Y	Special version	

FMP 40-											Product designation (part 1)

1) Rod and coaxial probes are also available in Alloy C22. In this case the probe rod is fixed to the instrument and can not be dismantled.

30 Probe length

Rope probes: 1000 mm...35000 mm / 40 in...1378 in

A	mm, 4 mm rope, 316
B	mm, 6 mm rope, 316
C	in, 1/6" rope, 316
D	in, 1/4" rope, 316

Rod probes: min. 300 mm...4000 mm / 12 in...157 in

K	mm, rod 16 mm, 316L
L	mm, coax probe, 316L
M	in (0,1 in), rod 16 mm, 316L
N	in (0,1 in), coax probe, 316L

Rod probes: min. 300 mm...2000 mm / 12 in...80 in

P	mm, rod 6 mm, 316L
R	in (0,1 in), rod 6 mm, 316L
Y	Special version

40 Sealing

2	FKM O-ring (e.g. Viton)	temperature -30° C...+150° C
3	EPDM O-ring	temperature -40° C...+120° C
4	FFKM O-ring (e.g. Kalrez)	temperature -5° C...+150° C
9	Special version	

50 Process connection, material

	Threaded connection	*Material*
CNJ	¾" NPT	316L
CRJ	G ¾", ISO 228	1.4435
GNJ	1½" NPT	316L
GRJ	G 1½", ISO 228	1.4435

	Flange Dia/Pressure	*Standard*	*Material*
CFJ	DN40 PN40	DIN 2526 Form C	316L
CGJ	DN50 PN40	DIN 2526 Form C	316L
CMJ	DN80 PN16	DIN 2526 Form C	316L
CQJ	DN100 PN16	DIN 2526 Form C	316L
CTJ	DN100 PN40	DIN 2526 Form C	316L
CWJ	DN150 PN16	DIN 2526 Form C	316L
CXJ	DN200 PN16	DIN 2526 Form C	316L
ACJ	1½"/150 lbs	ANSI B16.5	316L
ADJ	1½"/300 lbs	ANSI B16.5	316L
AEJ	2"/150 lbs	ANSI B16.5	316L
AFJ	2"/300 lbs	ANSI B16.5	316L
ALJ	3"/150 lbs	ANSI B16.5	316L
AMJ	3"/300 lbs	ANSI B16.5	316L
APJ	4"/150 lbs	ANSI B16.5	316L
AQJ	4"/300 lbs	ANSI B16.5	316L
AWJ	6"/150 lbs	ANSI B16.5	316L
A3J	8"/150 lbs	ANSI B16.5	316L
KDJ	10 K 40A	JIS B2210	316L
KEJ	10 K 50A	JIS B2210	316L
KLJ	10 K 80A	JIS B2210	316L
KPJ	10 K 100A	JIS B2210	316L
YY9	Special version		

60 Electronic insert / Communication

B	2-wire, 4…20 mA HART
D	2-wire, PROFIBUS-PA
F	2-wire, Foundation Fieldbus
G	4-wire, 90...250 VAC, 4...20 mA HART
H	4-wire, 10,5...32 VDC, 4...20 mA HART
Y	Special version

FMP 40- Product designation (part 2)

70	**Display**	
	1	without display
	2	with display VU 331 incl. on-side operation
	9	Special version
80	**Remote electronic**	
	1	Standard compact device
	2	distance sleeve 400 mm for electronic
	3	remote electronic, 3 m cable
	9	Special version
90	**Housing and cable gland / entry**	
		housing / *cable gland/-entry*
	A	aluminium F12-housing, coated, IP68 / cable gland M20x1,5
	B	aluminium F12-housing, coated, IP68 / cable entry G ½
	C	aluminium F12-housing, coated, IP68 / cable entry ½ NPT
	D	aluminium F12-housing, coated, IP68 / M12 PROFIBUS-PA plug
	E	aluminium F12-housing, coated, IP68 / 7/8" FF-plug
	G	aluminium T12-housing, coated, IP68 / cable gland M20x1,5
	H	aluminium T12-housing, coated, IP68 / cable entry G ½
	J	aluminium T12-housing, coated, IP68 / cable entry ½ NPT
	K	aluminium T12-housing, coated, IP68 / M12 PROFIBUS-PA plug
	L	aluminium T12-housing, coated, IP68 / 7/8" FF-plug
	9	Special version
100	**Additional options**	
	A	Additional options not selected
	B	3.1.B material, wetted parts SS316Ti, Inspection Certificate EN 10204, acc. specification 52005759
	Y	Special version
FMP 40-		Complete product designation

⇓

Please enter probe length in mm or inch / 0.1 inch

☐☐☐☐☐ mm

☐☐☐☐☐ inch / 0.1 inch

probe length LN see page 12

2.2 Scope of delivery

Caution!
It is essential to follow the instructions concerning the unpacking, transport and storage of measuring instruments given in the chapter »Incoming acceptance, transport, storage« on page 11

The scope of delivery consists of:
- Assembled instrument
- 2 ToF Tool CD-ROMs
  – CD 1: ToF Tool Program
  – CD 2: Device descriptions (device drivers) and documentation for all Endress+Hauser devices which are operable using ToF Tool
- Accessories (s. Chapter 8)

Accompanying documentation:
- Short manual (basic equalisation/troubleshooting): housed in the instrument
- Operating manual (this manual)
- Operating manual: Description of the instrument functions
- Approval documentation: if this is not included in the operating manual.

2.3 Certificates and approvals

CE mark, declaration of conformity
The instrument is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The instrument complies with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". The instrument described in this manual thus complies with the statutory requirements of the EG directives. Endress+Hauser confirms the successful testing of the instrument by affixing to it the CE mark.

2.4 Registered trademarks

KALREZ ®, VITON ®, TEFLON ®
Registered trademark of the company E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP ®
Registered trademark of the company Ladish & Co., Inc., Kenosha, USA

HART ®
Registered trademark of HART Communication Foundation, Austin, USA

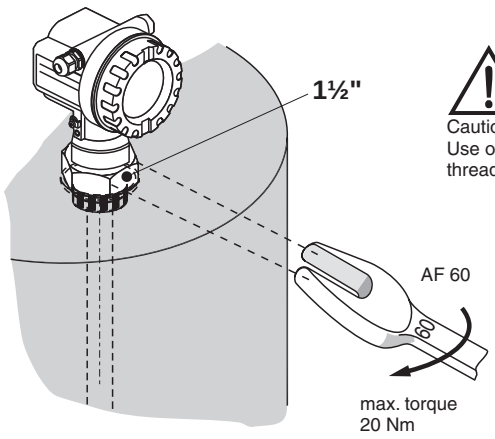
ToF ®
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

PulseMaster ®
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

3 Mounting

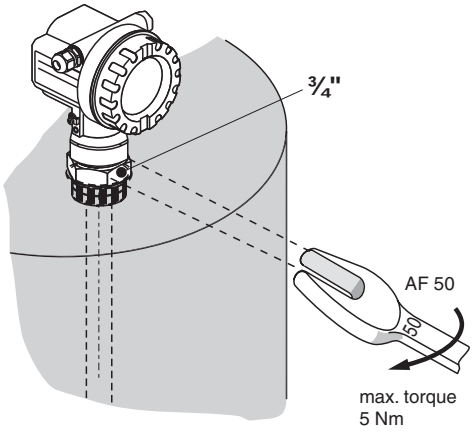
3.1 Quick installation guide

F12 or T12 housing



Caution!
Use only the
threaded boss ???

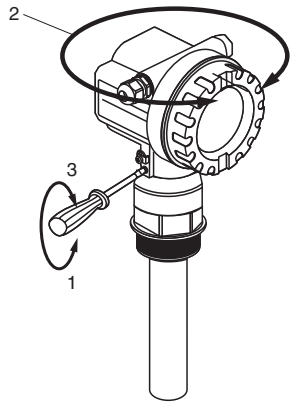
F12 or T12 housing



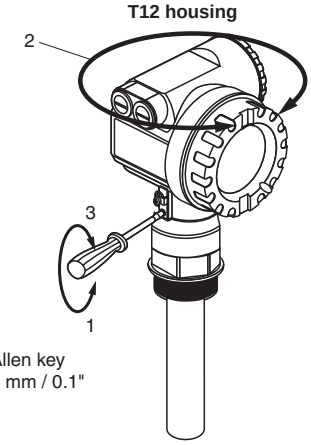
Turn housing

The housing can be turned 350°
in order to simplify access to the
display and the terminal compartment

F12 housing



T12 housing



Allen key
4 mm / 0.1"

3.2 Incoming acceptance, transport, storage

3.2.1 Incoming acceptance

Check the packing and contents for any signs of damage.
Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.2.2 Transport

Caution!
Follow the safety instructions and transport conditions for instruments of more than 18 kg. Do not lift the measuring instrument by its probe rod in order to transport it.

3.2.3 Storage

Pack the measuring instrument so that is protected against impacts for storage and transport. The original packing material provides the optimum protection for this.
The permissible storage temperature is -40 °C…+80 °C.

3.3 Installation Conditions

3.3.1 Dimensions

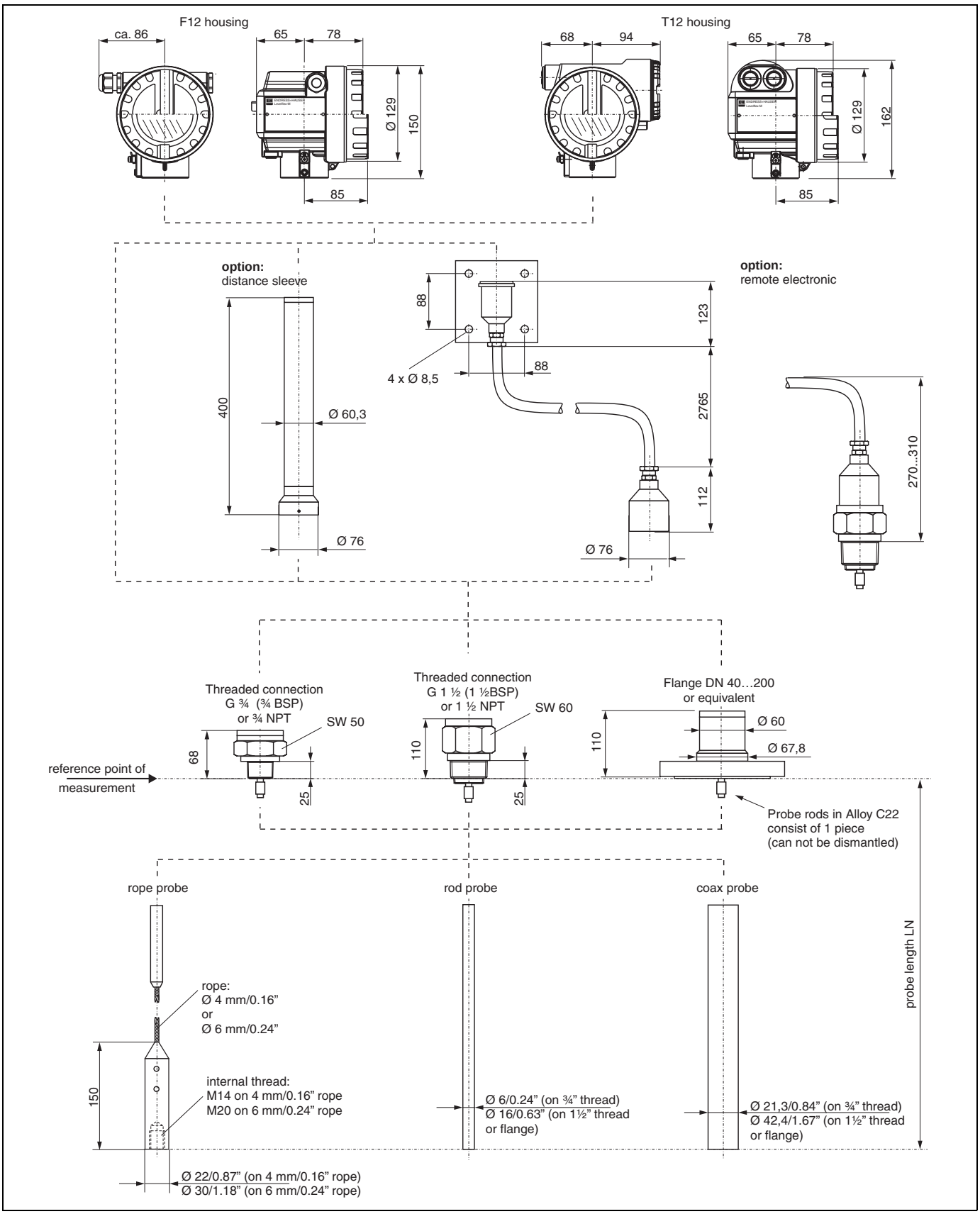


Fig. 2 Dimensions Levelflex M FMP 40

3.4 Installation

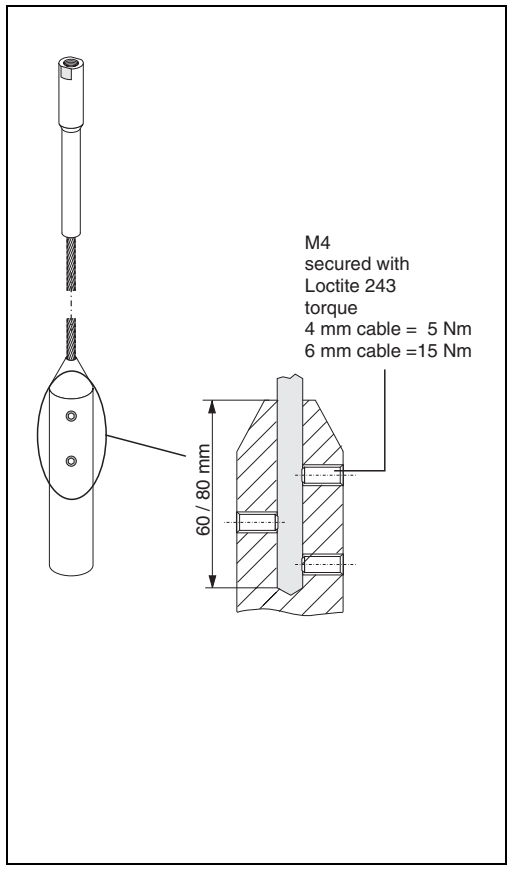
3.4.1 Mounting kit

In addition to the tool needed for flange mounting, you will require the following tool:
- 4 mm Allen wrench for turning the housing.

Shortening probes
Rod and rope probes can be easily shortened. This is necessary if the distance to the container floor or outlet cone is less than 150 mm in the case of a rope probe, or less than 100 mm in the case of a rod probe or less than 50 mm in the case of a coax probe.

Shortening rod probes
The rods of a rod probe are shortened by sawing or separating at the bottom end.

Shortening rope probes
- Remove ballast weight:
  – The weight is fixed to the probe rope with 3 Allen setscrews (M4, Allen key AF3). The screws are secured with Loctite. This may first have to be made plastic with a hot air apparatus.
- Remove released rope from the weight
- Measure off new rope length
- Wrap adhesive tape around the rope at the point to be shortened to prevent it from fanning out.
- Saw off the rope at a right angle or cut it off with a bolt cutter.
- Insert the rope completely into the weight,
  – thin rope (4 mm) 60 mm deep,
  – thick rope(6 mm) 80 mm deep



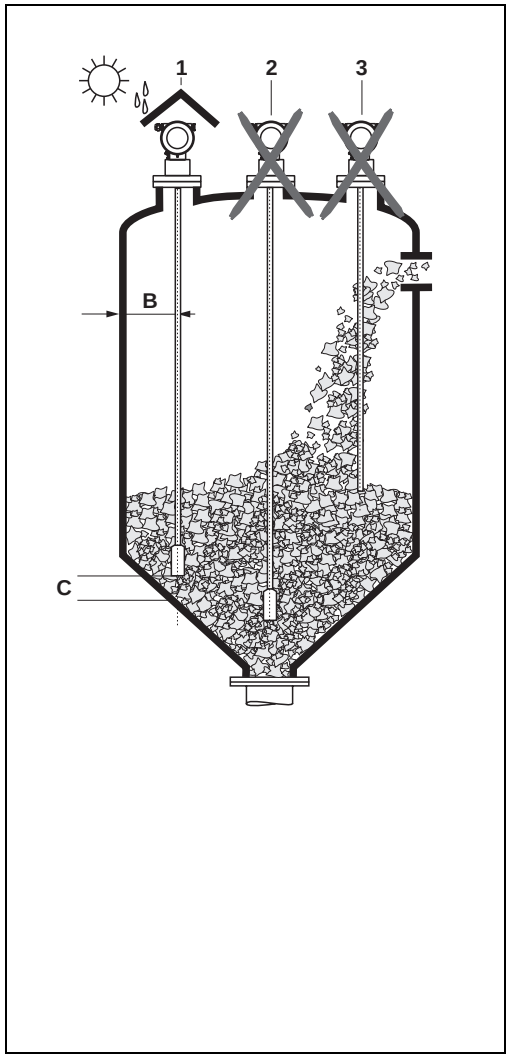
The weight is then refixed to the rope:
- Reapply screw locking fluid (we recommend Loctite type 243) to the setscrews and screw into place.
- When doing so, observe the following torques:
  – For 6 mm rope: 15 Nm
  – For 4 mm rope: 5 Nm

Shortening coax probes
Coax probes can be shortened max. 80 mm from the end. They have centering units inside which fix the rod centrally in the pipe. The centerings are held with borders on the rod. Shortening is possible up to approx. 10 mm below the centering.

3.4.2 Engineering hints for level measurement in bulk solids and fluids

The following installation instructions apply for rope and rod probes for measurement in bulk solids and fluids.
Coax probes are suitable purely for measurement in fluids. They function practically independent of all installation conditions and can, therefore, be installed as desired.
- Temperature conditions must be met (see page 81).
- It is recommended that a protective cover (1) is used, in order to protect the transmitter against direct sunlight or rain (see »Accessories« on page 67.).

Mounting location
- Do not mount rod or rope probes in the filling curtain (3)
- Mount rod and rope probes away from the wall (B) at such a distance that, in the event of build-up on the wall, there is still a minimum distance of 100 mm between the probe and the build-up.
- Mount rod and rope probes as far away as possible from installed fittings. "Mapping " must be carried out during commissioning in the event of distances < 300 mm.
- When installing rod and rope probes in plastic containers, the minimum distance of 300 mm also applies to metallic parts outside the container.
- Rod and rope probes may not, at times, contact metallic container walls or floors.
- In metal containers, do not install rod and rope probes exactly in the centre (2).
- Minimum distance of probe end to the container floor (C):
  – Rope probe: 150 mm
  – Rod probe: 100 mm
  – Coax probe: 50 mm
- When installing outdoors, it is recommended that you use a protective cover (1) see »Accessories« on page 67..

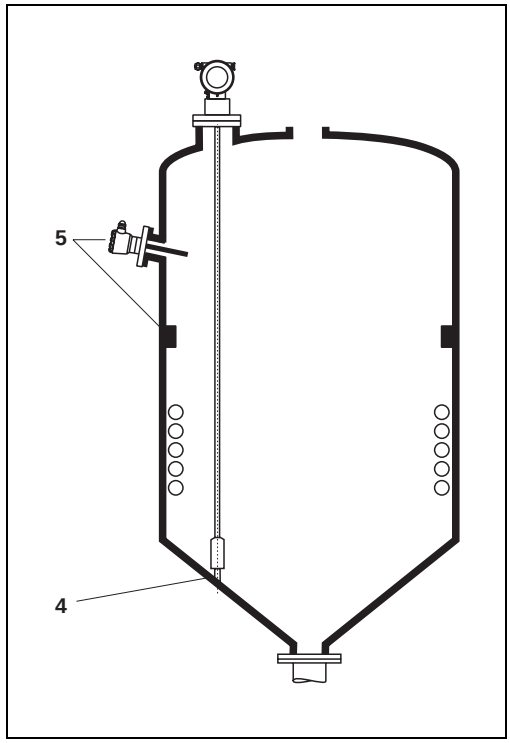


Other installations

- Select the mounting location such that the distance to internals (5) (e.g. limit switch, struts) > is 300 mm over the entire length of the probe, also during operation.
- Probe must within the measuring span not touch any internals during operation. If necessary: when using rope probes the probe end (4) may be fixed to ensure that (see page 23)!.

Optimization options

- Interference echo suppression: Measurement can be optimised by electronically tuning out interference echoes.



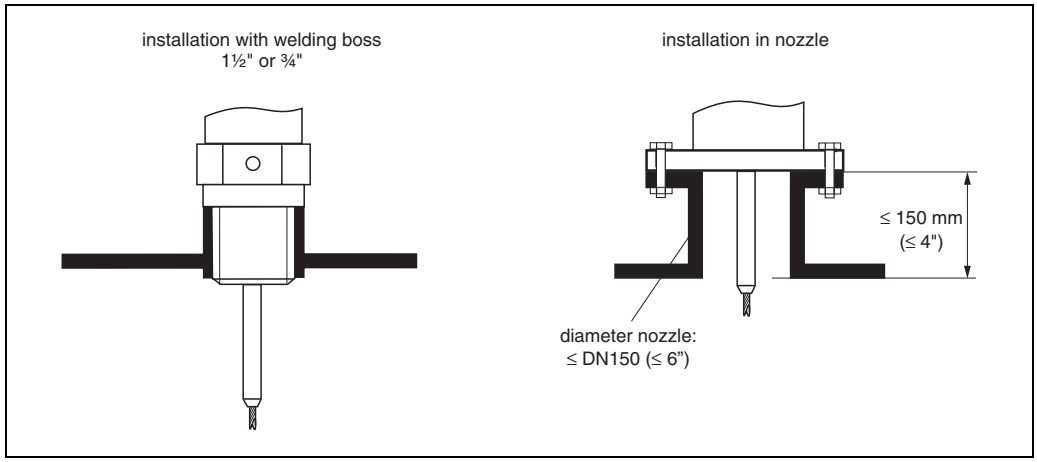
Minimum distance B of the probe to the container wall:

Wall	min. distance B
Metal	100 mm for smooth walls
Plastic	100 mm, min. 300 mm to metallic components outside of the tank
Concrete	0.5 m/20", otherwise the max. possible measuring range is reduced

Distance to protruding internals min. 300 mm.

Standard installation

- Probes are mounted to the process connection with threaded connections or flanges and are usually also secured with these. If during this installation there is the danger that the probe end moves so much that it touches the tank floor or cone at times, the probe must, if necessary, be shortened and fixed down. The easiest way to fix the rope probes is to screw them to the internal thread on the lower end of the weight. Thread size, see page 23.
- The ideal installation is mounting in a screwed joint / screw-in sleeve which is internally flush with the container ceiling.
- If installation takes place in a nozzle, the nozzle should be 50 ... 150 mm in diameter and should not be more than 150 mm high. Installation adapters are available for other dimensions, see »Accessories« on page 67.

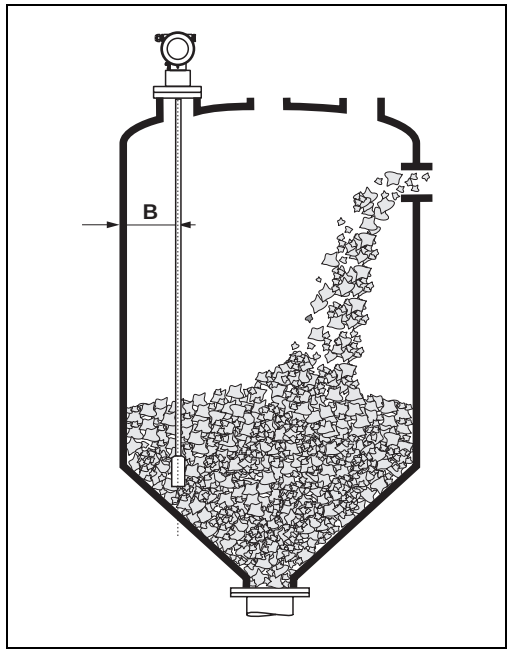


Probe length

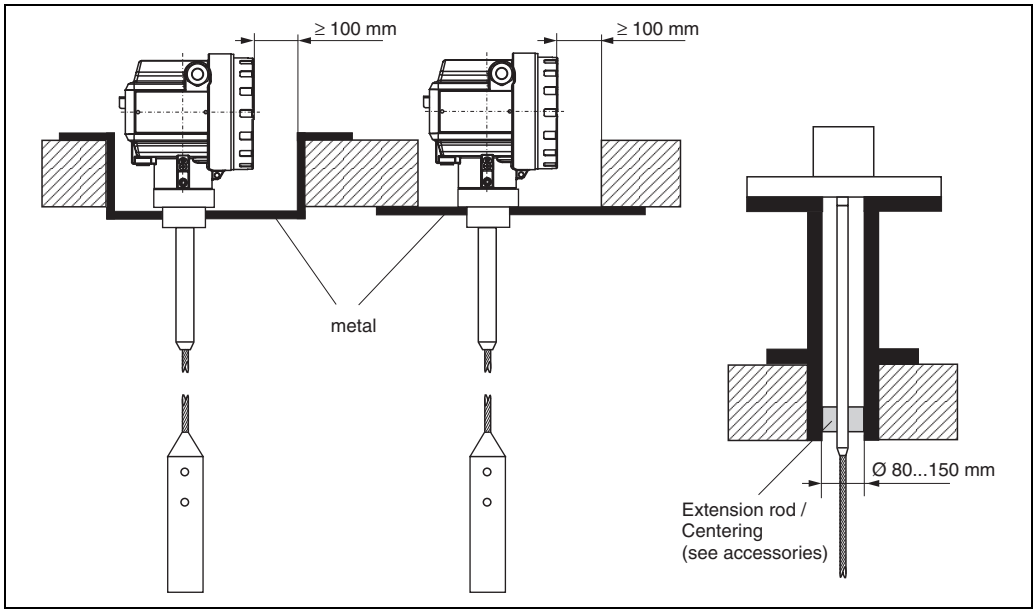
- The measuring range is directly dependent on the probe length. If the probe is not fixed at the bottom end, the following distances to the container floor must be observed:
  – Rope probe: 150 mm
  – Rod probe: 100 mm
  – Coax probe: 30 mm
  It is better to order probes too long than too short since it is possible to shorten the probe if necessary.

3.4.3 Special notes for bulk solids

- In the case of bulk solids, as great a distance as possible from the filling curtain is especially important to avoid wear.
- In concrete silos, a **large distance** (B) should be observed between the probe and the concrete wall, if possible >= 1m, but at least 0.5m



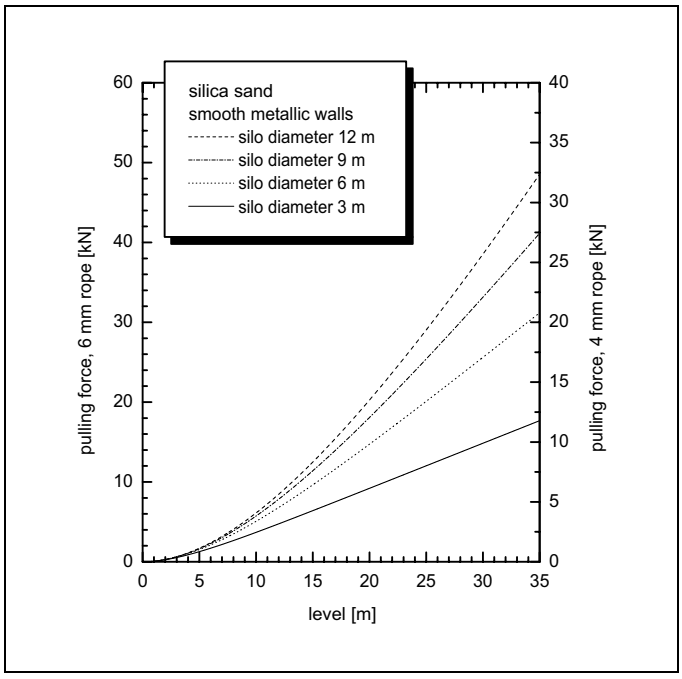
Installation in concrete silos
Installation, for example, into a thick concrete ceiling should be made flush with the lower edge. Alternatively, the probe can also be installed into a pipe that must not protrude over the lower edge of the silo ceiling. Installation suggestions see diagram.

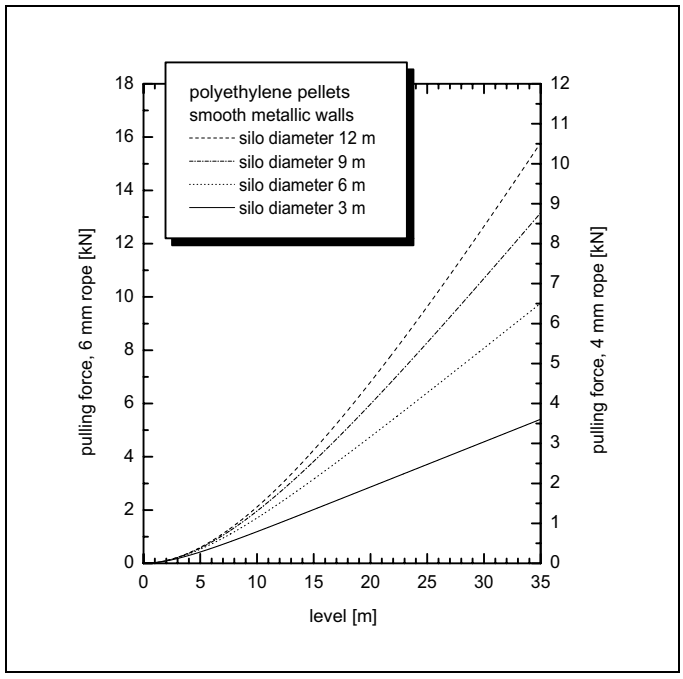


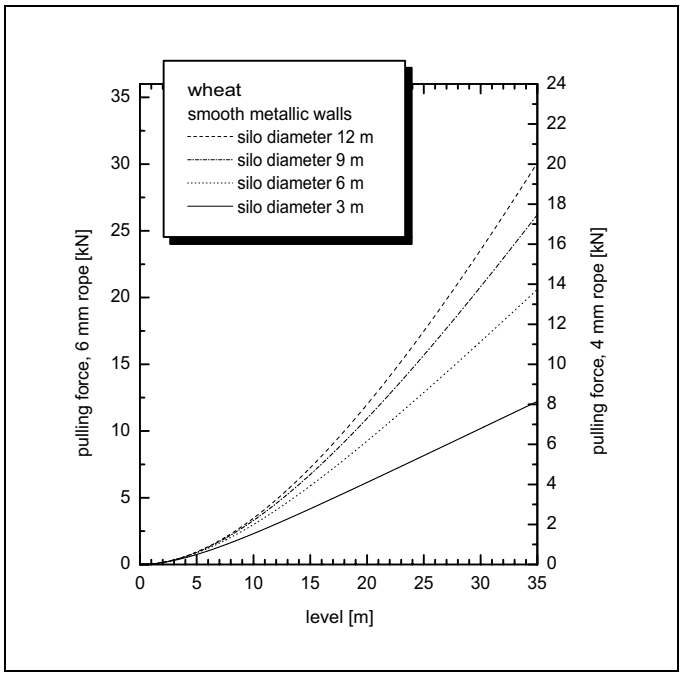
3.4.4 Installation in bulk solid silos

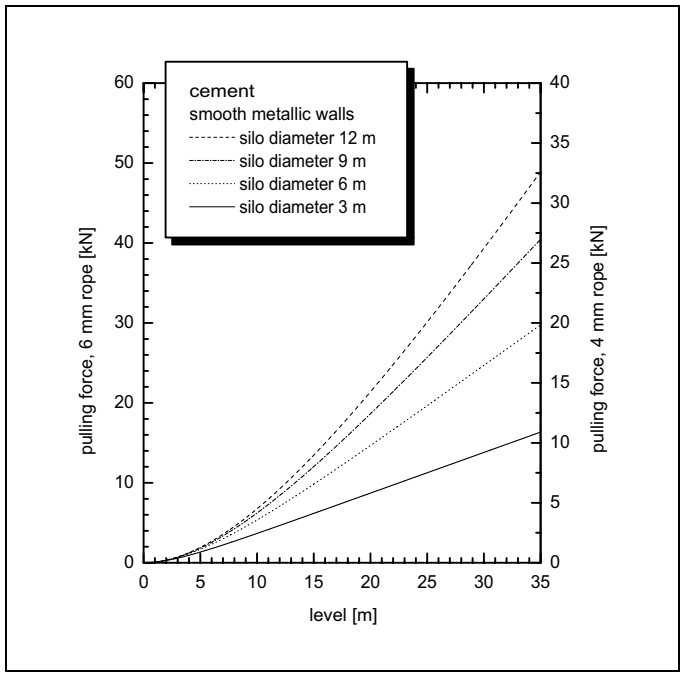
Tensile load
Bulk solids exert tensile forces on rope probes whose height increases with::
- the length of the probe, i.e. max. cover,
- the bulk density of the product,
- the silo diameter and
- the diameter of the probe rope

The following diagrams show typical loads for frequently occurring bulk solids as reference values. The calculation is performed for the following conditions:
- Suspended probe (probe end not fixed at the bottom)
- Free-flowing bulk solid, i.e. mass flow. A calculation for core flow is not possible. In the event of collapsing cornices, considerably higher loads can occur.
- The specification for tensile forces contains the safety factor 2, which compensates for the normal fluctuation range in pourable bulk solids.









Since the tensile forces are also heavily dependent on the viscosity of the product, a higher safety factor is necessary for highly viscous products and if there is a risk of cornice build-up.
In critical cases it is better to use a 6 mm rope instead of a 4 mm one.

The same forces also act on the silo cover.
On a fixed rope, the tensile forces are definitely greater, but this can not be calculated. Observe the tensile strength of the probes or ensure that the tensile strength of the probes is not exceeded.
Options for reducing the tensile forces:
- Shorten the probe
- If the maximum tensile load is exceeded, check whether it would be possible to use a non-contact ultrasonic device.

3.4.5 Installation in liquids tanks

- When installing in agitation units, check whether a no-contact process (ultrasonic or radar) would be better suited, especially if the agitator generates large mechanical loads on the probe.
- If Levelflex is, nevertheless, installed in tanks with agitators, it is better to use coax probes which have a greater lateral loading capacity.

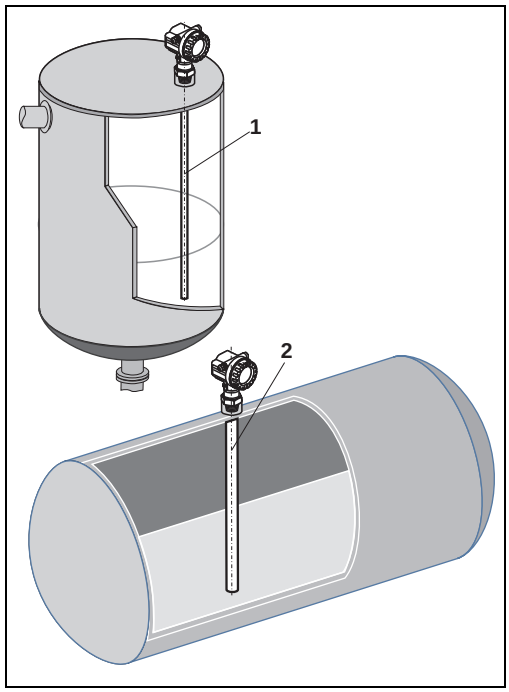
Standard installation

Using a coax probe offers great advantages when the viscosity of the product is ≤ 500 cst and it is certain that the product does not accumulate build-up:

- Greater reliability:
  As of dielectric constant=1.4, measurement functions independently of all electrical properties in all liquids.
- Internals in the tank and nozzle dimensions do not have any influence on measurement.
- Higher lateral load-bearing capacity than rod probes.
- For higher viscosity a rod probe is recommended, or using a non-contact measuring principle.

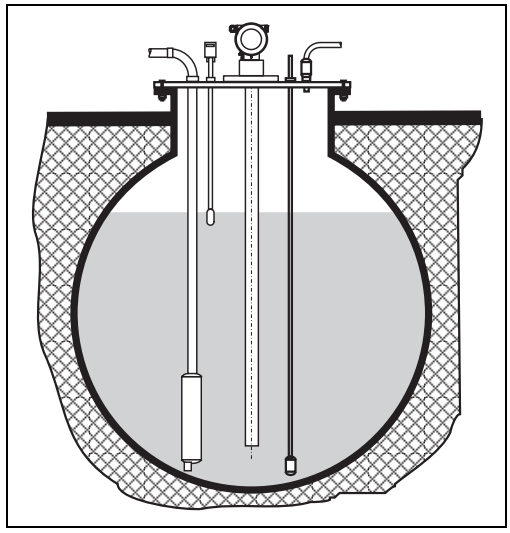
Installation in horizontal cylindrical and standing tanks

- Use a coax or rod probe for measuring ranges up to 4 m. For anything over this or if there is too free cover space use a 4 mm rope probe.
- Installation and possible fixing as with bulk solids.
- Any distance from wall, as long as occasional contact is prevented.
- Do not mount a rod or rope probe (1) exactly central when using metallic containers. Central mounting doesn't impair coax probe (2) performance.
- When installing in tanks with a lot of internals or internals situated close to the probe: Use a coax probe.



Installation in underground tanks

- Use coax probe for nozzles with large diameters in order to avoid reflections at the nozzle wall.

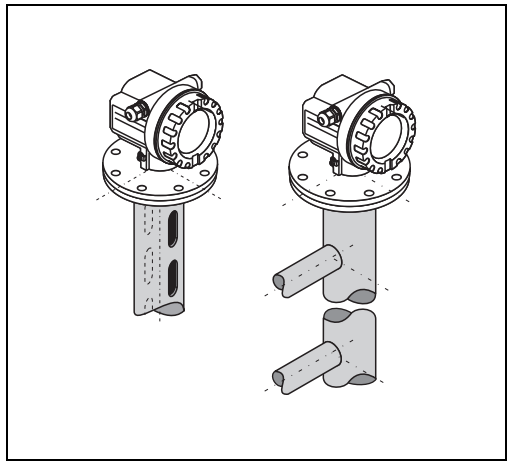


Measurement in corrosive fluids

For measurement in corrosive liquids, it is possible to install a rod probe in a closed plastic pipe with a diameter of up to approx. 50 mm. When using plastic tanks it is also possible to mount the probe on the outside of the tank (see Installation instructions on page 24). Levelflex measures the level through the plastic in both cases.

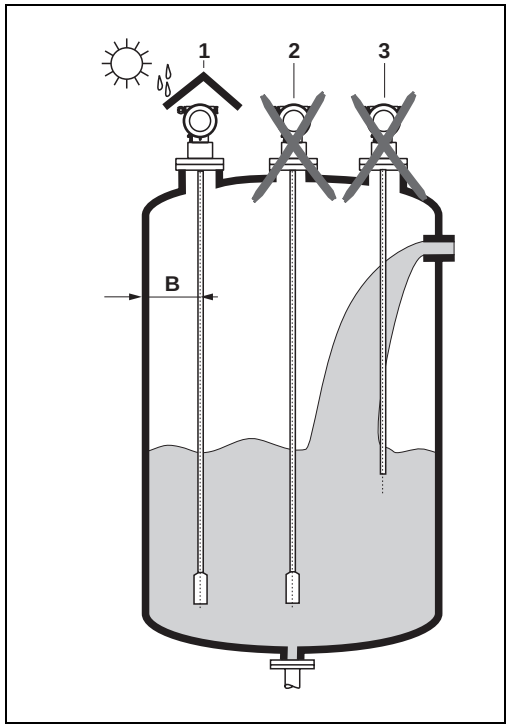
Installation in stilling well or bypass

- A rod probe can be used for pipe diameters up to 150 mm, for diameters above that the flange with horn adapter recommended.
- When installing a rod probe into a metallic pipe with internal diameter of up to 150 mm, you have all the advantages of a coax probe.
- Welded joints that protrude up to approx.
  5 mm/0.2" inwards do not influence measurement.



Mounting Location

- Recommended distance B wall-mounted rope probe: ~1/6...1/4 of the container diameter (min. 100 mm/4", concrete silos: min. 500 mm).
- Not central (2) in metallic tanks.
- Not in the filling curtain (3).
- Please order the probe length such that it ends approx 30 mm above the floor of the tank.
- Temperature conditions must be met.
- It is recommended that a protective cover (1) be used, in order to protect the transmitter against direct sunlight or rain. Mounting and demounting are carried out simply with a clamp (see »Accessories« on page 67.).

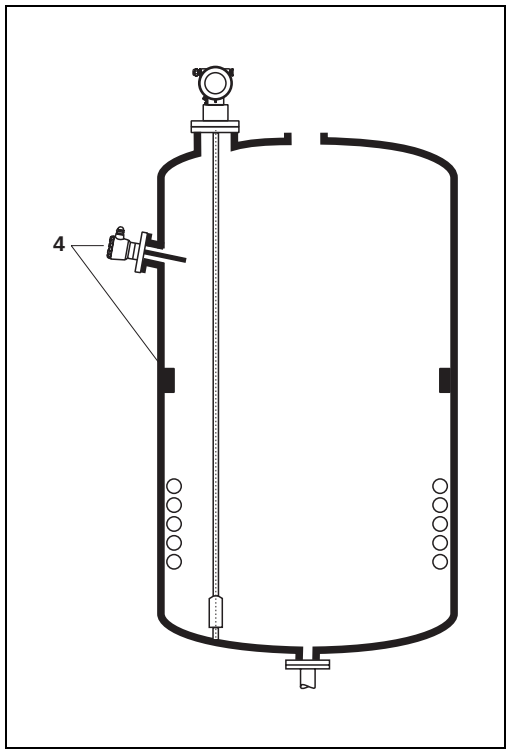


Tank installations

- Select the mounting location such that the distance to internals (4) (e.g. limit switch, struts) is > 300 mm.

Optimization options

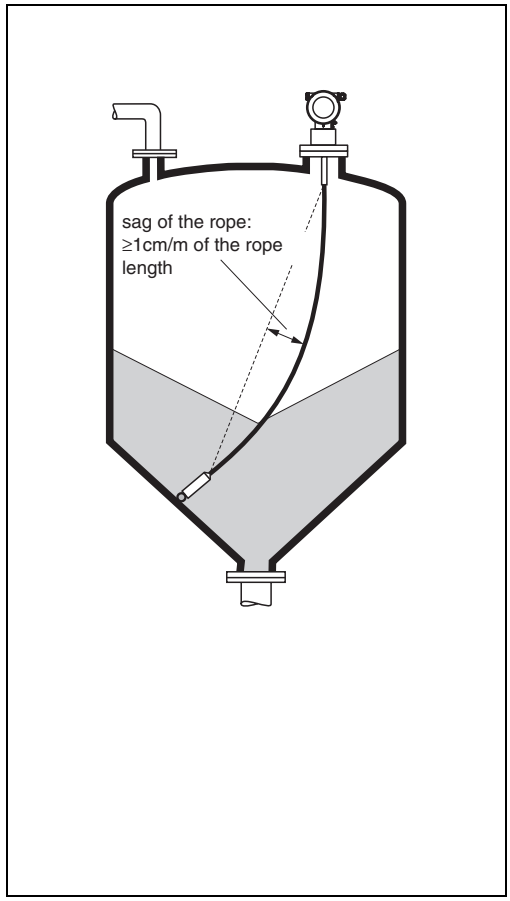
- Interference echo suppression: Measurement can be optimised by electronically tuning out interference echoes.
- Bypass pipe and stilling well (only for liquids): for viscosities of up to 500 cst, a bypass pipe, stilling well or a coax probe can be used to prevent interference.

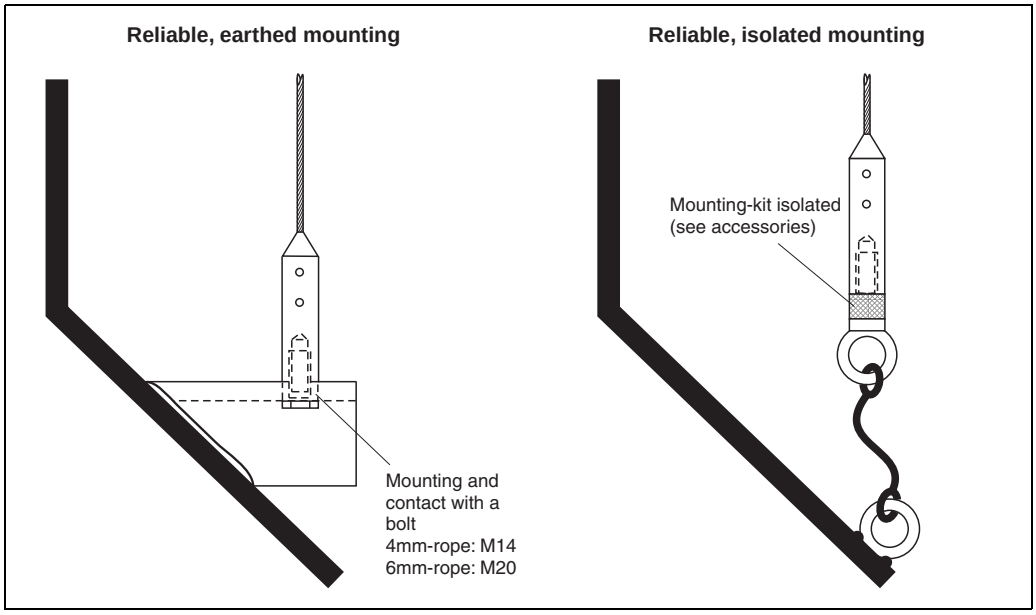


3.4.6 Notes on special installation situations

Fixing rope probe

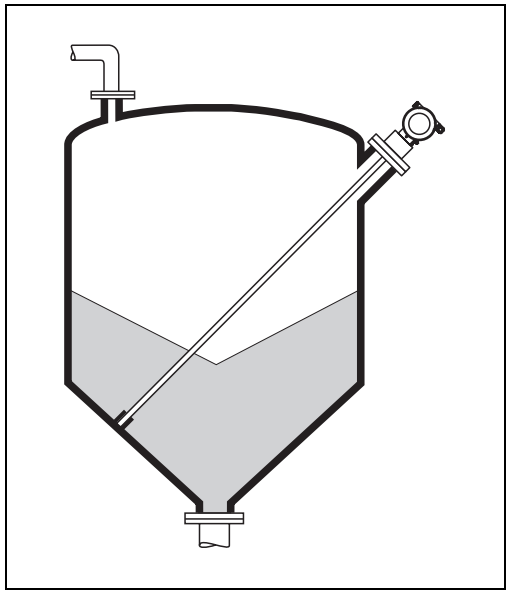
- The end of the probe needs to be secured if the probe would otherwise touch the silo wall, the cone or another part, or the probe comes closer than 0.5 m to a concrete wall. This is what the internal thread in the probe weight is intended for:
  – for 4 mm rope:M14
  – for 6 mm rope:M20
- Preferably use the 6 mm rope probe due to the higher tensile strength when fixing a rope probe
- The fixing must be either reliably grounded or reliably insulated (see accessories). If it is not possible to mount the probe weight with a safe earthed connection, it can be secured using an isolated eyelet, which is available as an accessory (see page 69).
- In order to prevent an extremely high tensile load and the risk of rope crack, the rope has to be slack. Make the rope longer than the required measuring range such that there is a sag in the middle of the rope that is ≥ 1cm/m (1"/100") of the rope length.





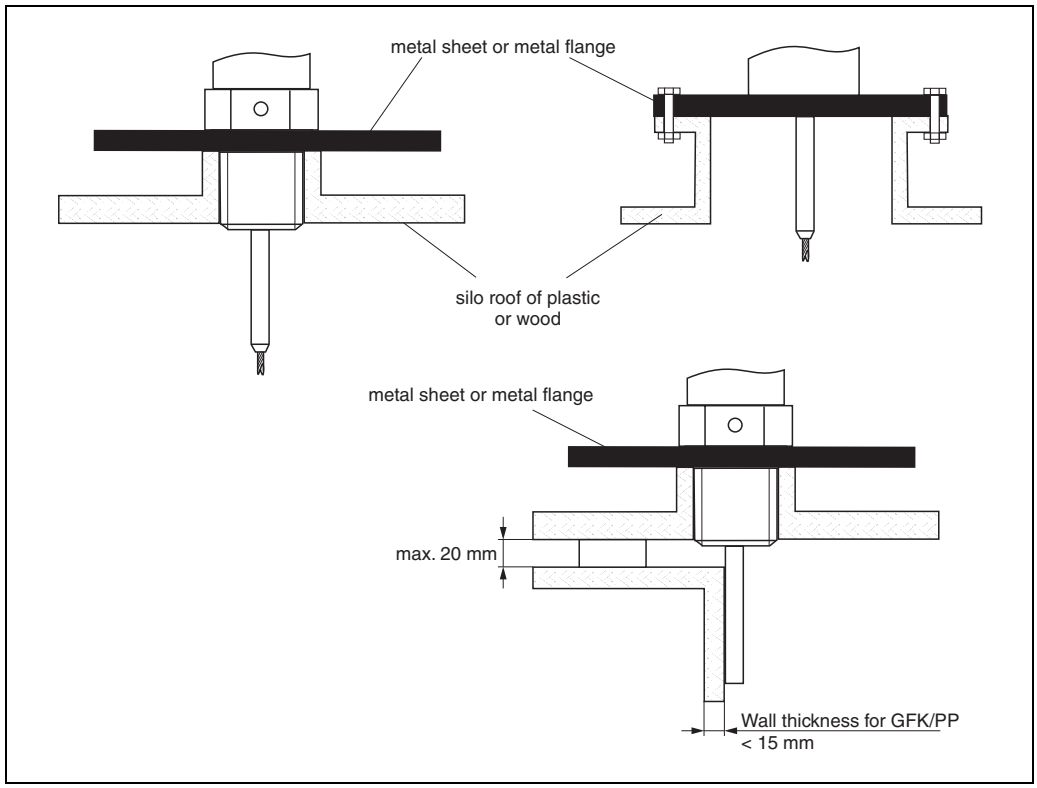
Installation from the side

- If installation from above is not possible, the Levelflex can also be mounted from the side.
- In this case, always fix the rope probe (see »Fixing rope probe«).
- Support coax probe if the lateral load-bearing capacity is exceeded. Only fix rod probes at the probe end.
- Connect rod probe metallically with the container wall.



Installation in plastic containers

Please note that for rod and rope probes only with a metallic surface at the process connection an optimal performance can be guaranteed.
When installing the probe in plastic silos, whose silo cover is also made of plastic or silos with wood cover, the probes must either be mounted in a ≥ DN50 / 2" metallic flange, or a metal sheet with diameter of ≥ 200 mm must be mounted under the screw-in piece.

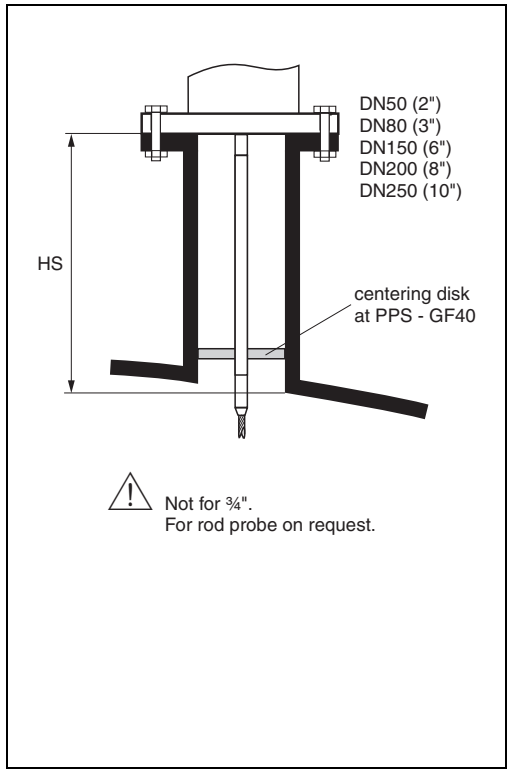


- It is also possible to mount the probe externally on the tank wall for measuring in Aqueous solutions. Measurement then takes place through the tank wall without contacting the medium. If people are in the vicinity of the probe mounting location, a plastic half pipe with a diameter of approx. 200 mm, or some other protective unit, must be affixed externally to the probe to prevent any influences on the measurement.
- There must not be any metallic reinforcement rings secured to the tank.
- The wall thickness should be at Fibre-Glass Reinforced Plastic/PP < 15 mm.
- There must be no open space between the tank wall and the probe.

- If measuring externally, an automatic probe length determination and a two point linearisation must be performed in order to compensate for the time-of-flight change caused by the plastic wall.

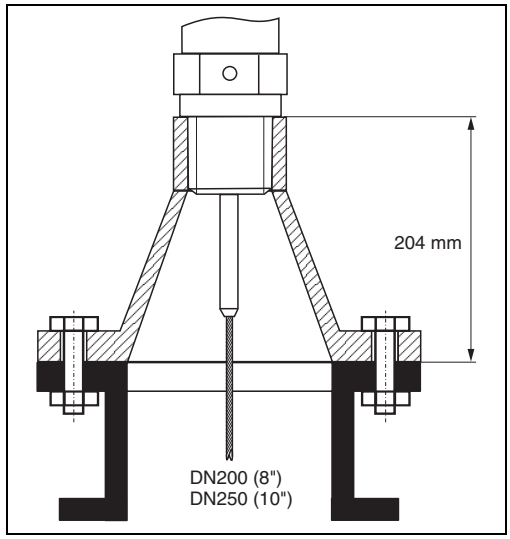
Installation in nozzles > 150 mm high

If, when installing probes in nozzles DN 40...250/1 ½"...10" with nozzle height (HS) of > 150 mm/6", the probe could touch the lower edge of the nozzle due to moving materials in the container, we recommend using an extension rod with or without centering disk.
This accessory consists of the extension rod corresponding to the nozzle height, on which a centering disk is also mounted if the nozzles are narrow or when working in bulk solids. This component is delivered separately from the device. Please order the probe length correspondingly shorter.
For the exact length of the rod
see page 68.
Order codes for specific nozzle nominal diameters and heights can be found on page 68.
Only use centering disks with small diameters (DN 40 and DN 50) if there is no significant build-up in the nozzle above the disk.

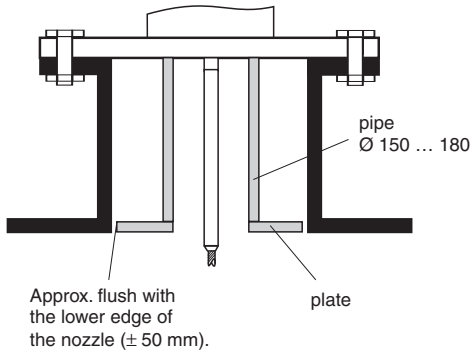


Installation in DN 200/DN 8" and DN 250/DN 10"nozzles

When installing the Levelflex in nozzles of ≥ 210 mm / 8", signals are generated by reflections on the nozzle wall, which can sometimes lead to faulty measurements in the case of products with small dielectric constants With nozzle diameters of 200 mm / 8" or 250 mm / 10", therefore, a special flange with a “horn adaptor” must be fitted.
Nozzles with nominal diameters greater than DN 250 / 10" should be avoided.



Installation in ≥ DN 300/DN 12" nozzles
If installation in ≥ 300mm/12" nozzles is unavoidable, installation must be carried out in accordance with the sketch on the right.

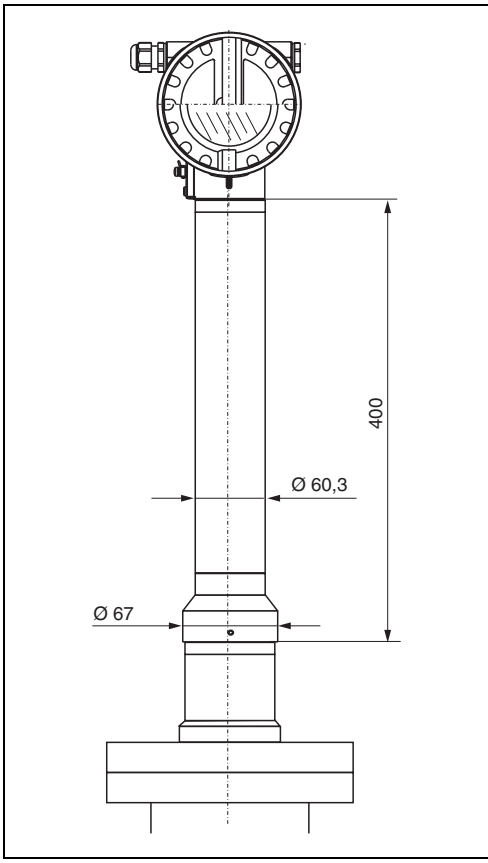


nozzle diameter	plate diameter
DN 300	280
≥ DN 400	≥ 350

3.4.7 Installation for difficult to access process connections

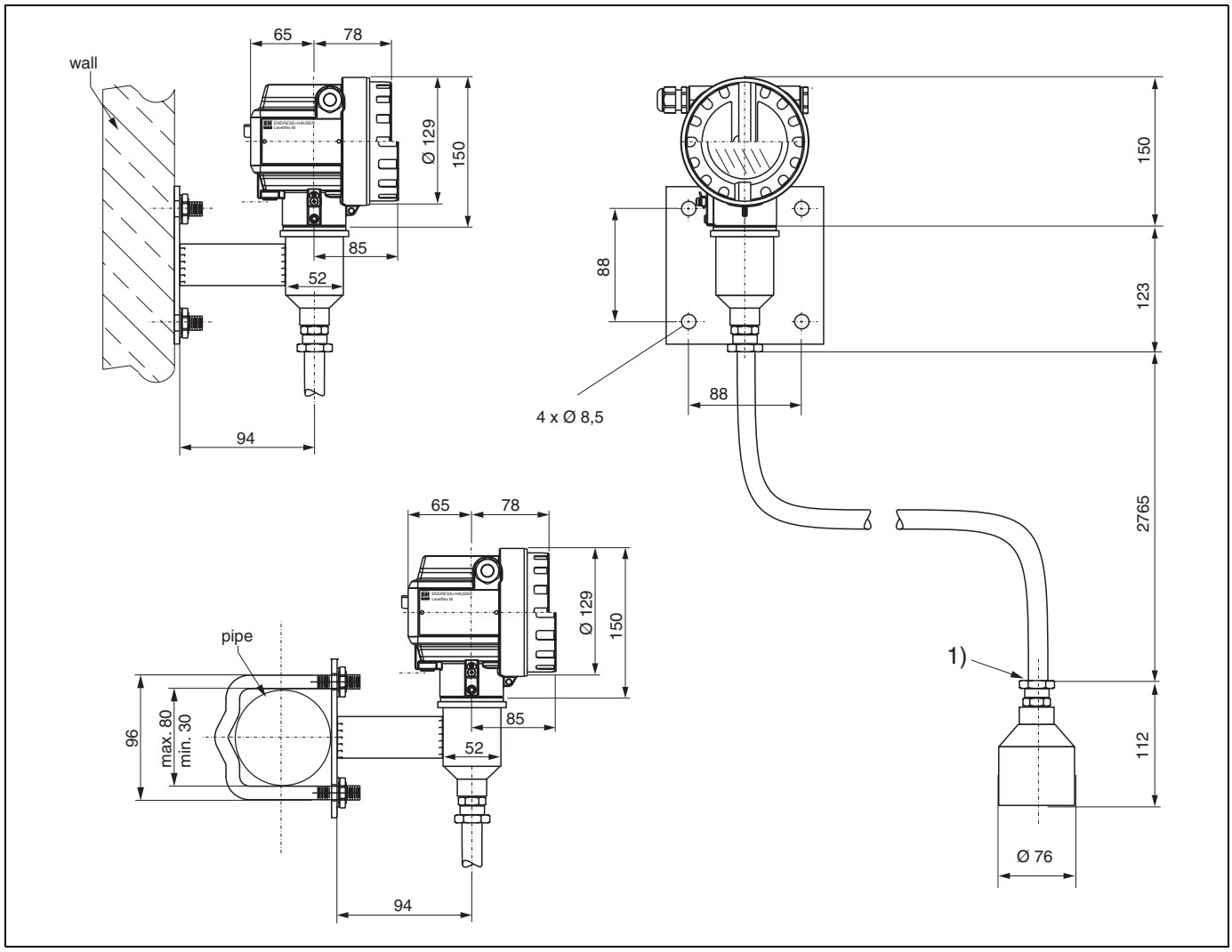
For tight spaces or temperatures above that in the graphic, the electronics housing can be ordered with distance pipe or connecting cable (seperate housing).

Installation with distance pipe
- Follow installation instructions on Page 14 ff..
- After mounting, the housing can be turned 350°, in order make access to the display and the connection compartment easier.
- The max. measuring range is reduced to 34 m/1338".



Installation with separate housing

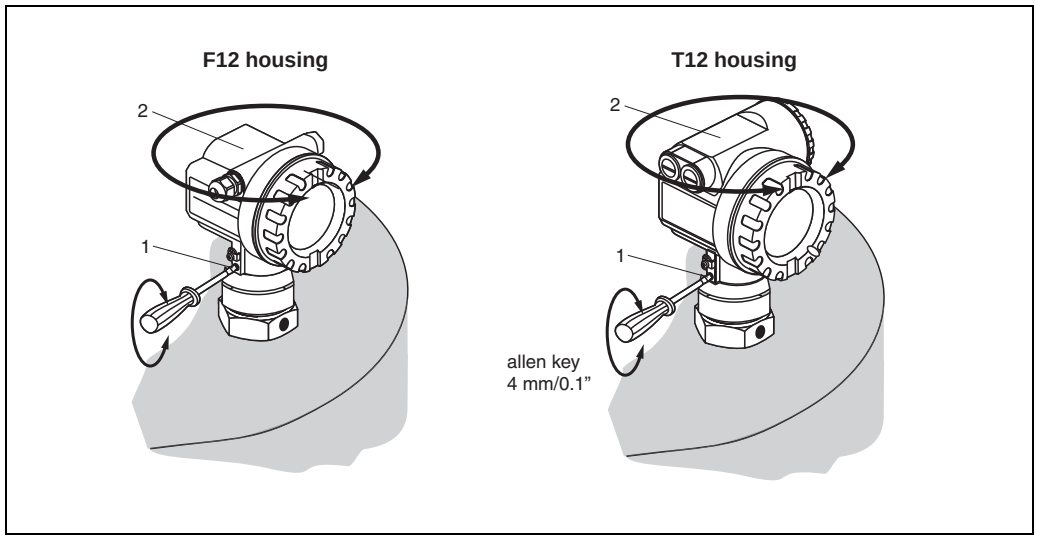
- Follow installation instructions on Page 14 ff..
- Mount housing on a wall or pipe as shown in the diagram.



The separate housing is designed for use at high environmental temperatures at the mounting location of the sensor. The max. measuring range is reduced to 30 m/1181". The version with separate housing consists of the probe, a connecting cable and the housing. If they are ordered as a set, they are assembled on delivery.
1) The protective hose can not be dismantled at this point.

3.4.8 Turn housing

After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment. Proceed as follows to turn the housing to the required position:
- Undo the fixing screws (1)
- Turn the housing (2) in the required direction
- Tighten up the fixing screws (1).



3.5 Post-installation check

After the measuring instrument has been installed, perform the following checks:
- Is the measuring instrument damaged (visual check)?
- Does the measuring instrument correspond to the measuring point specifications such as process temperature/pressure, ambient temperature, measuring range, etc.?
- Are the measuring point number and labeling correct (visual check)?
- Is the measuring instrument adequately protected against rain and direct sunlight (see Page 67 ff.)?

4 Wiring

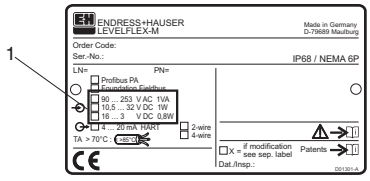
4.1 Quick wiring guide

Wiring in F12 housing

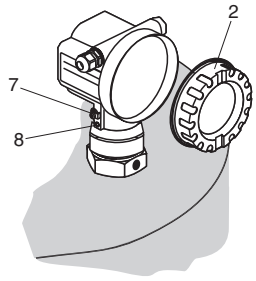
Caution!

Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal (7) before connecting up the device.
- Tighten the locking screw (8):
  It forms the connection between the probe and the housing ground potential.



When you use the measuring system in hazardous areas, make sure you comply with national standards and the specifications in the safety instructions (XA's). Make sure you use the specific cable gland.

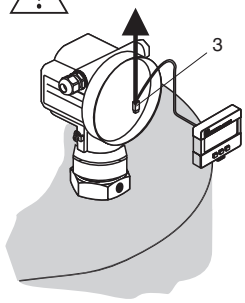


EX

On devices supplied with a certificate, the explosion protection is designed as follows:

- Housing F12 - EEx ia:
  Power supply must be intrinsically safe.
- The electronics and the current output are galvanically separated from the probe circuit.

Unplug display connector!



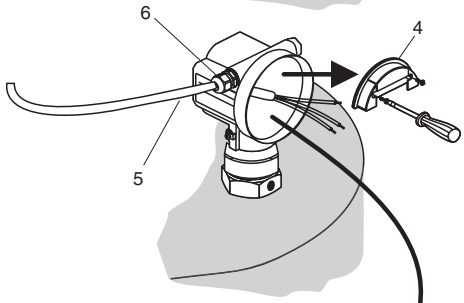
Connect up the Levelflex M as follows:

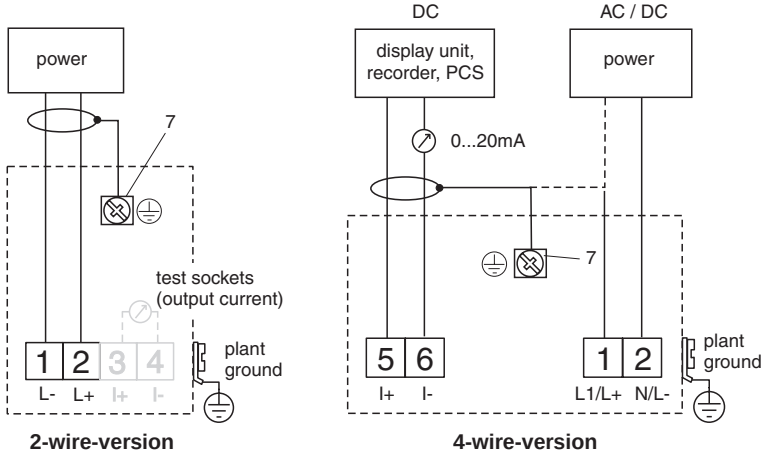
- Unscrew housing cover (2).
- Remove any display (3) if fitted.
- Remove cover plate from terminal compartment (4).
- Pull out terminal module slightly using "pulling loop" (only 2-wire).
- Insert cable (5) through gland (6).
  Use screened, twisted wire pair.

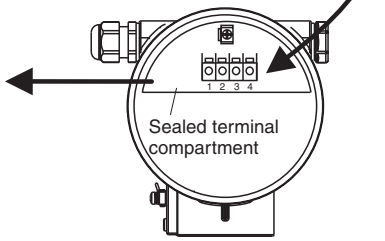
EX

Only ground screening of the line (7) on sensor side.

- Make connection (see pin assignment).
- Re-insert terminal module.
- Tighten cable gland (6). Max. torque 10...12 Nm!
- Tighten screws on cover plate (4).
- Insert display if fitted.
- Screw on housing cover (2).
  (on dust-Ex torque ≈ 40 Nm).
- Switch on power supply.







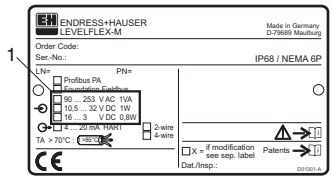
Note!
If 4-wire for dust-Ex-applications is used, the current output is **intrinsically save**.

Wiring in T12 housing

Caution!

Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal (7) before connecting up the device.
- Tighten the locking screw (8): It forms the connection between the probe and the housing ground potential.



When you use the measuring system in hazardous areas, make sure you comply with national standards and the specifications in the safety instructions (XA's). Make sure you use the specific cable gland.

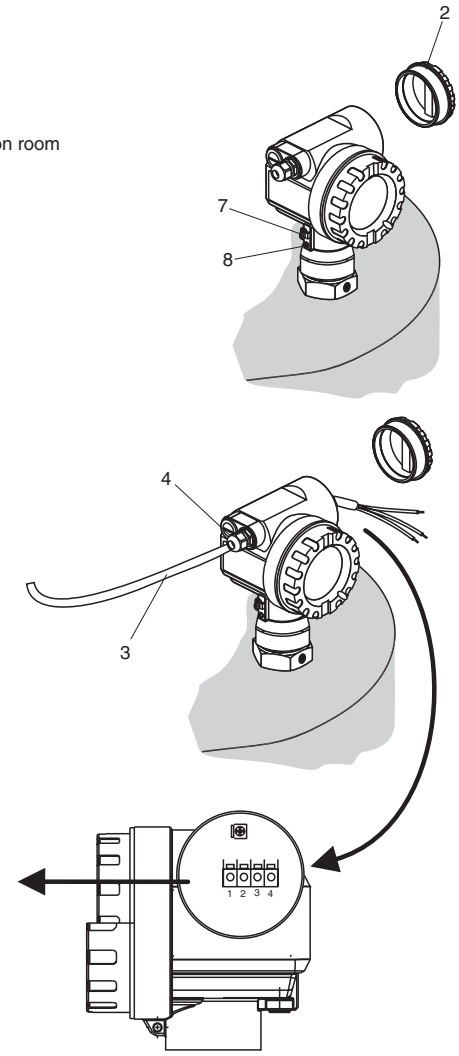
Connect up the Levelflex M as follows:

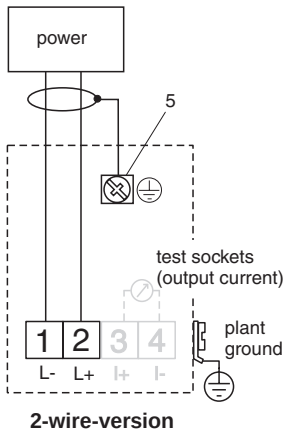
EX Before unscrew housing cover (2) at seperate connection room turn off the power supply!

- Insert cable (3) through gland (4). Use screened, twisted wire pair.

EX Only ground screening of the line (5) on sensor side.

- Make connection (see pin assignment).
- Tighten cable gland (4). Max. torque 10...12 Nm!
- Screw on housing cover (2) (on dust-Ex torque ≈ 40 Nm).
- Switch on power supply.

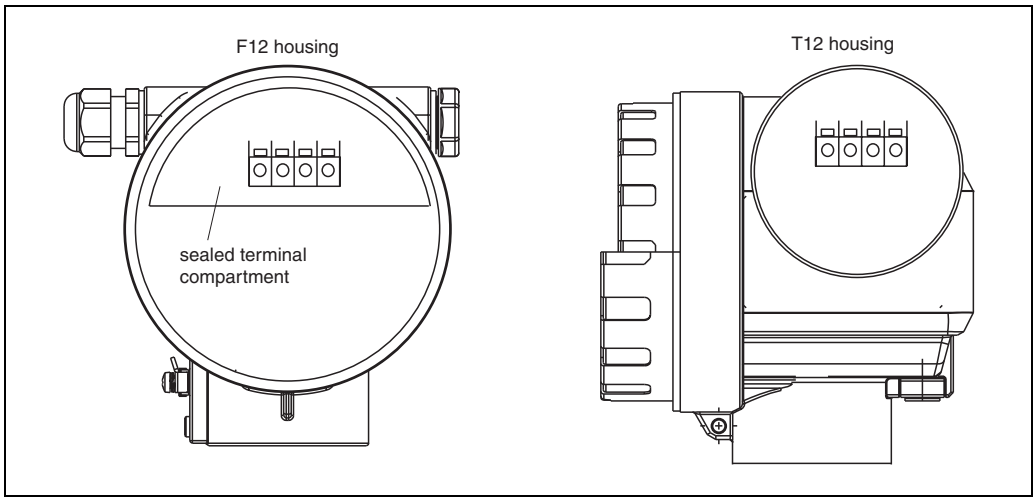




2-wire-version

4.2 Connecting the measuring unit

Terminal compartment
Two housings are available:
- Housing F 12 with additionally sealed terminal compartment for standard or EEx ia
- Housing T 12 with separate terminal compartment for standard, EEx e or EEx d.



The instrument data are given on the nameplate together with important information regarding the analog output and voltage supply. Housing orientation regarding the wiring, see »Turn housing« on page 28.

Load HART
Minimum load for Hart communication: 250 Ω

Cable entry
Cable gland: M20x1.5
Cable entry: G ½ or ½ NPT

Supply voltage
HART, 2-wire
The following values are the voltages across the terminals directly at the instrument:

Communication		Current consumption	Terminal voltage	
			minimal	maximal
HART	standard	4 mA	16 V	36 V
		20 mA	7,5 V	36 V
	EEx ia	4 mA	16 V	30 V
		20 mA	7,5 V	30 V
	EEx em EEx d	4 mA	16 V	30 V
		20 mA	11 V	30 V
Fixed current (HART multidrop-operation)	standard	11 mA	10 V	36 V
	EEx ia	11 mA	10 V	30 V

HART, 4-wire active

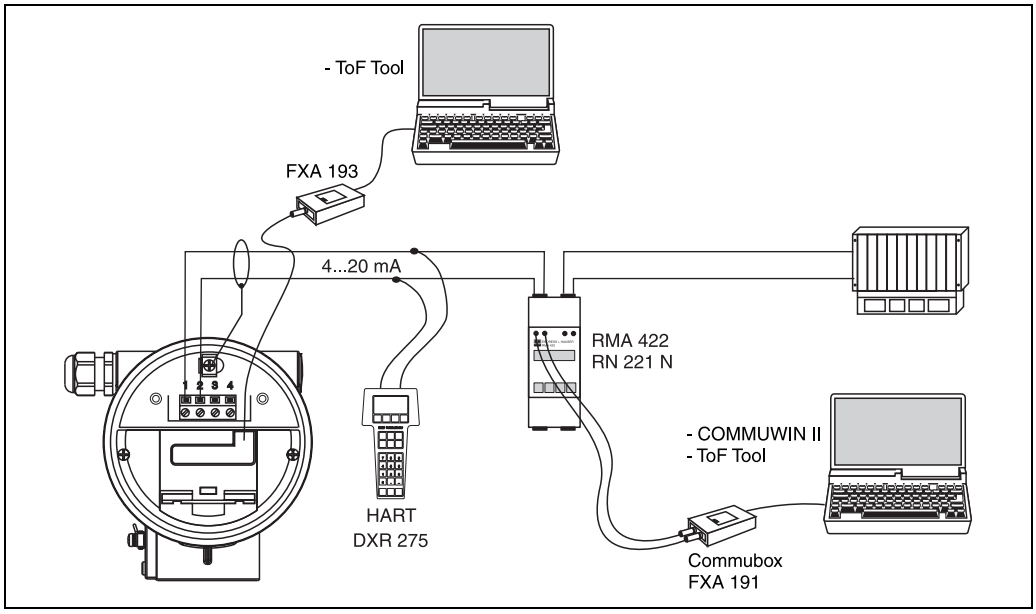
Version	Voltage	Max. load
DC	10,5...32 V	600 Ω
AC	85...250 V	600 Ω

Power consumption
min. 60 mW, max. 900 mW

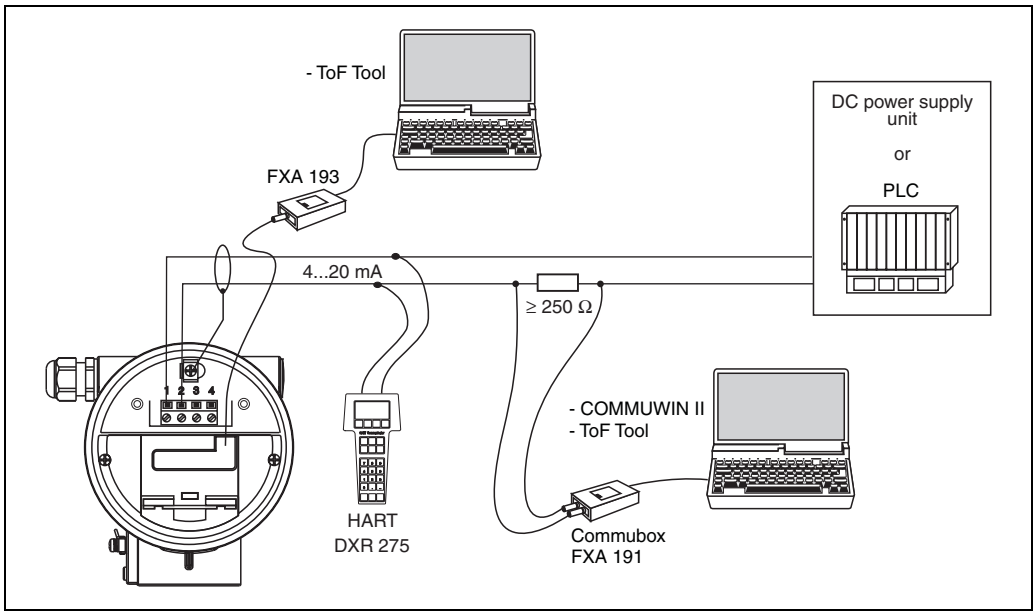
Current consumption

Communication	Current consumption	Current consumption Power consumption
HART, 2-wire	3,6…22 mA	—
HART, 4-wire (90...250 V_{AC})	2,4...22 mA	~ 3...6 mA / ~ 3.5 VA
HART, 4-wire (10,5...32 V_{DC})	2,4...22 mA	~ 100 mA / ~ 1 W
PROFIBUS-PA	max. 11 mA	—
Foundation Fieldbus (FF)	max. 15 mA	—

4.2.1 HART connection with E+H RMA 422 / RN 221 N



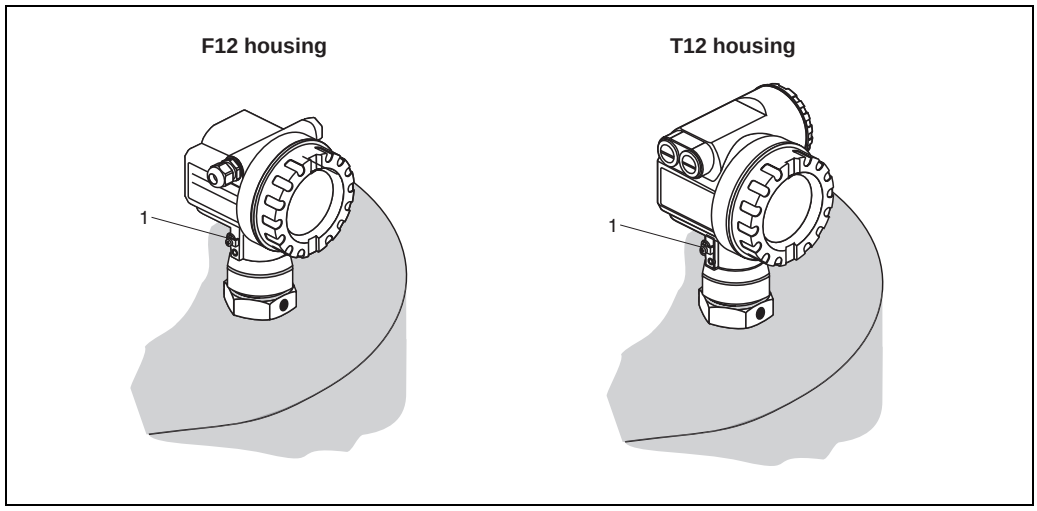
4.2.2 HART connection with other supplies



Caution!
If the HART communication resistor is not built into the supply unit and the HART interface is to be used, it is necessary to insert a communication resistor of 250 Ω into the 2-wire line.

4.3 Equipotential bonding

Connect the Equipotential bonding to the external ground terminal (1) of the transmitter.



Caution!
In Ex applications, the instrument must only be grounded on the sensor side. Further safety instructions are given in the separate documentation for applications in explosion hazardous areas.

4.4 Degree of protection

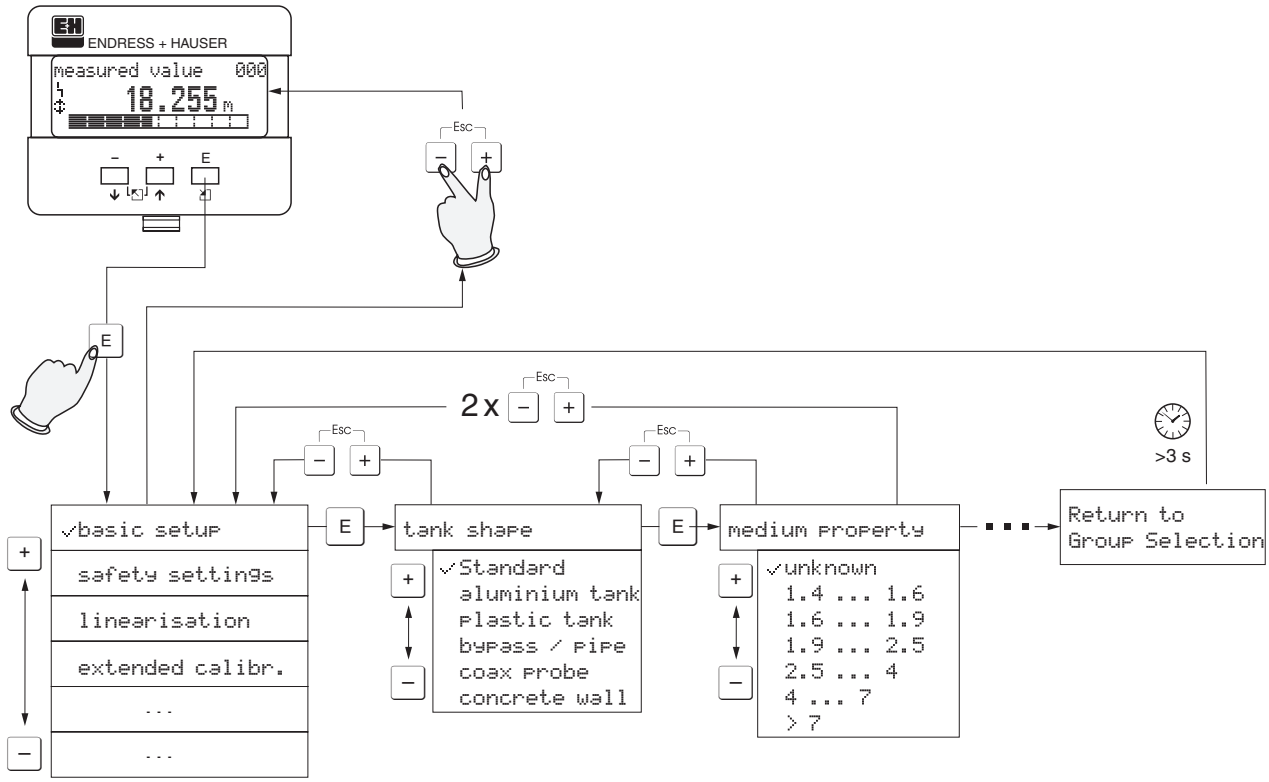
- housing: IP 68, NEMA 4X (open housing: IP20, NEMA 1)
- probe: IP 68 (NEMA 6P)

4.5 Post-connection check

After wiring the measuring instrument, perform the following checks:
- Is the terminal allocation correct (see Page 29 ff. and Page 30)?
- Is the cable gland tight?
- Is the housing cover screwed tight?
- If auxiliary power is available:
  Is the instrument ready for operation and is the liquid crystal display visible.

5 Operation

5.1 Quick operation guide



Selection and configuration in Operation menu:

1.) Change from Measured Value Display to **Group Selection** by pressing E

2.) Press − or + to select the required **Function Group** (e.g.. "basic setup (00)") and confirm by pressing E ➜ First **function** (e.g. "tank shape (002)") is selected.

Note!
The active selection is marked by a ✔ in front of the menu text.

3.) Activate Edit mode with + or −.

Selection menus:

a) Select the required **Parameter** in selected **function** (e.g. "tank shape (002)") with − or +.
b) E confirms selection ➜ ✔ appears in front of the selected parameter
c) E confirms the edited value ➜ system quits Edit mode
d) + / − (= Esc) interrupts selection ➜ system quits Edit mode

Typing in numerals and text:

a) Press + or − to edit the first character of the **numeral / text** (e.g. "empty calibr. (005)")
b) E positions the cursor at the next character ➜ continue with (a) until you have completed your input
c) if a ↵ symbol appears at the cursor, press E to accept the value entered ➜ system quits Edit mode
d) + / − (= Esc) interrupts the input, system quits Edit mode

4) Press E to select the next **function** (e.g. "medium property (003)")

5) Press + / − (= Esc) once ➜ return to previous **function** (e.g. "tank shape (002)")
Press + / − (= Esc) twice ➜ return to **Group selection**

6) Press + / − (= Esc) to return to **Measured value display**

5.1.1 General structure of the operating menu

The operating menu is made up of two levels:

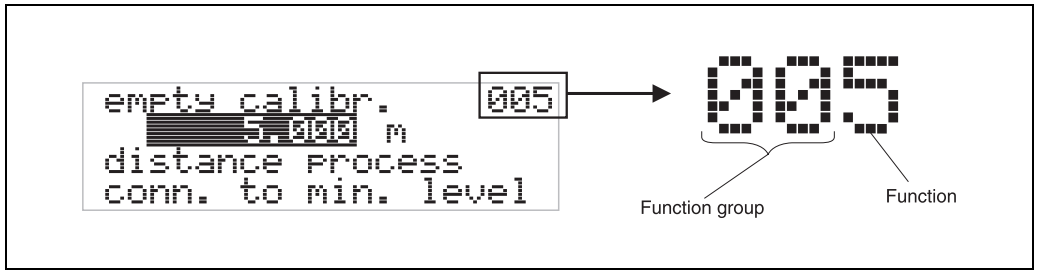
- **Function groups (00, 01, 03, …, 0C, 0D):**
  The individual operating options of the instrument are split up roughly into different function groups. The function groups that are available include, e.g.: "**basic setup**", "**safety settings**", "**output**", "**display**", etc.
- **Functions (001, 002, 003, …, 0D8, 0D9):**
  Each function group consists of one or more functions. The functions perform the actual operation or parameterisation of the instrument. Numerical values can be entered here and parameters can be selected and saved. The available functions of the "**basic setup (00)**" function group include, e.g.: "**tank properties**" **(002)**, "**medium property (003)**", "**process cond. (004)**", "**empty calibr. (005)**", etc.

If, for example, the application of the instrument is to be changed, carry out the following procedure:

1. Select the "**basic setup (00)**" function group.
2. Select the "**tank properties**" **(002)** function (where the existing tank shape is selected).

5.1.2 Identifying the functions

For simple orientation within the function menus, for each function a position is shown on the display.



The first two digits identify the function group:

- **basic setup** **00**
- **safety settings** **01**
- **linearisation** **04**

…

The third digit numbers the individual functions within the function group:

- **basic setup** **00** →
  - **tank properties** **002**
  - **medium property** **003**
  - **process cond.** **004**

  …

Here after the position is always given in brackets (e.g. "**tank properties**" **(002)**) after the described function.

5.2 Display and operating elements

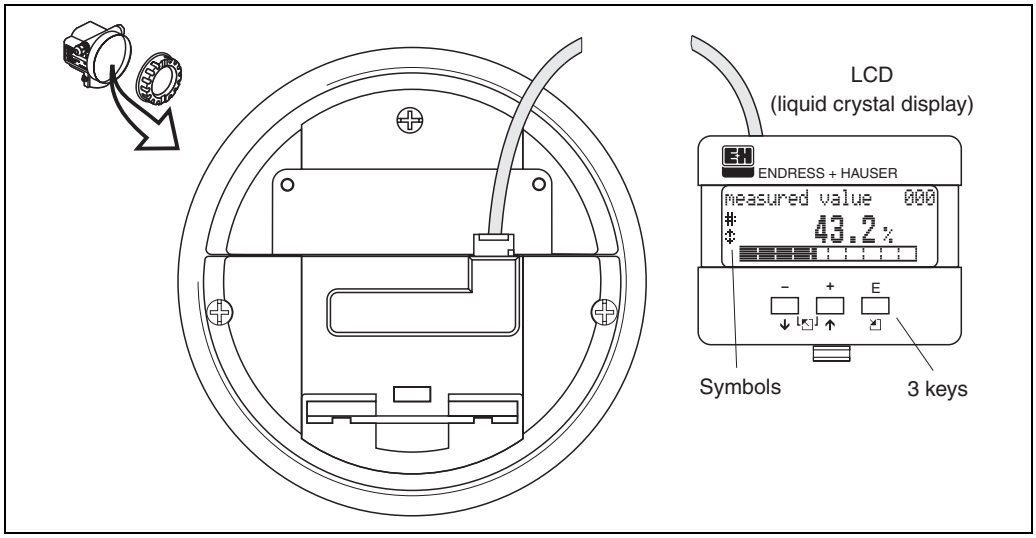


Fig. 3 Layout of the display and operating elements

5.2.1 Display

Liquid crystal display (LCD):
Four lines with 20 characters each. Display contrast adjustable through key combination.

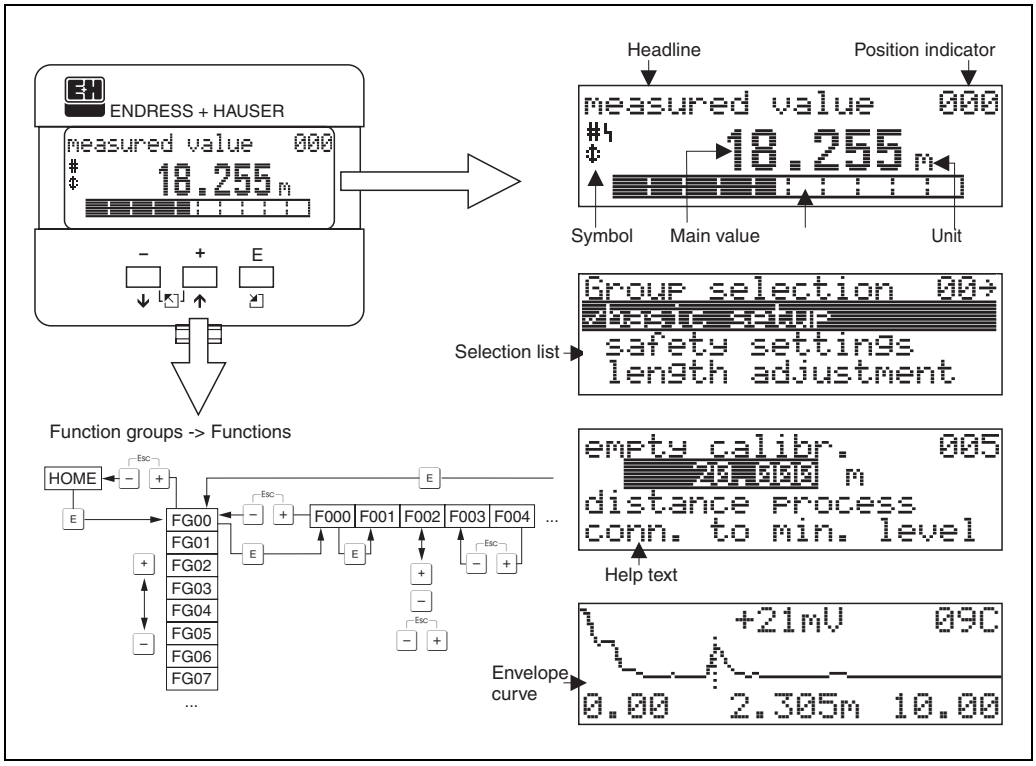


Fig. 4 Display

5.2.2 Display symbols

The following table describes the symbols that appear on the liquid crystal display:

Symbols	Meaning
	**ALARM_SYMBOL** This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning.
	**LOCK_SYMBOL** This lock symbol appears when the instrument is locked,i.e. if no input is possible.
	**COM_SYMBOL** This communication symbol appears when a data transmission via e.g. HART, PFOFIBUS-PA or Foundation Fieldbus is in progress.

Tab. 1 Meaning of Symbols

5.2.3 Key assignment

The operating elements are located inside the housing and are accessible for operation by opening the lid of the housing.

Function of the keys

Key(s)	Meaning
+ or ↑	Navigate upwards in the selection list Edit numeric value within a function
– or ↓	Navigate downwards in the selection list Edit numeric value within a function
Esc – + or ←	Navigate to the left within a function group
E or E	Navigate to the right within a function group, confirmation.
+ and E or – and E	Contrast settings of the LCD
+ and – and E	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

Tab. 2 Function of the keys

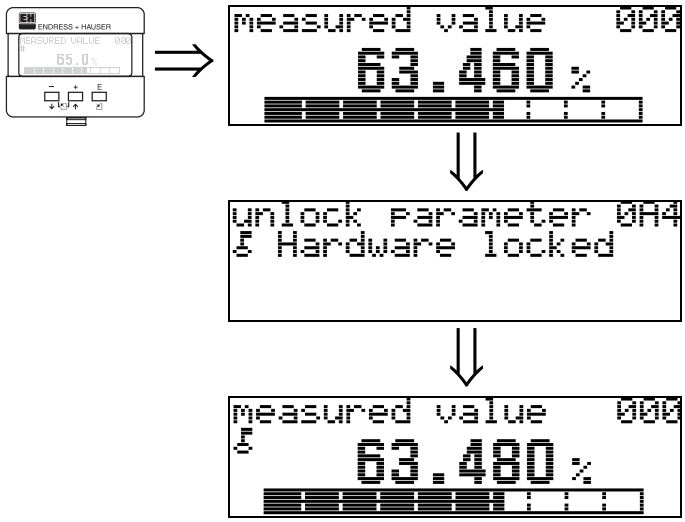
5.3 Local operation

5.3.1 Locking of the configuration mode

The Levelflex can be protected in two ways against unauthorised changing of instrument data, numerical values or factory settings:

"**unlock parameter**" **(0A4):**
A value **<> 100** (e.g. 99) must be entered in "**unlock parameter**" **(0A4)** in the "**diagnostics**" **(0A)** function group. The lock is shown on the display by the symbol and can be released again either via the display or by communication.

Hardware lock:
The instrument is locked by pressing the [+] and [–] and [E] keys at the same time. The lock is shown on the display by the symbol and can **only** be unlocked again via the display by pressing the [+] and [–] and [E] keys at the same time again. It is **not** possible to unlock the hardware by communication.
All parameters can de displayed even if the instrument is locked.



[+] and [–] and [E] press simultaneous

The LOCK_SYMBOL appears on the LCD.

5.3.2 Unlocking of configuration mode

If an attempt is made to change parameters when the instrument is locked, the user is automatically requested to unlock the instrument:

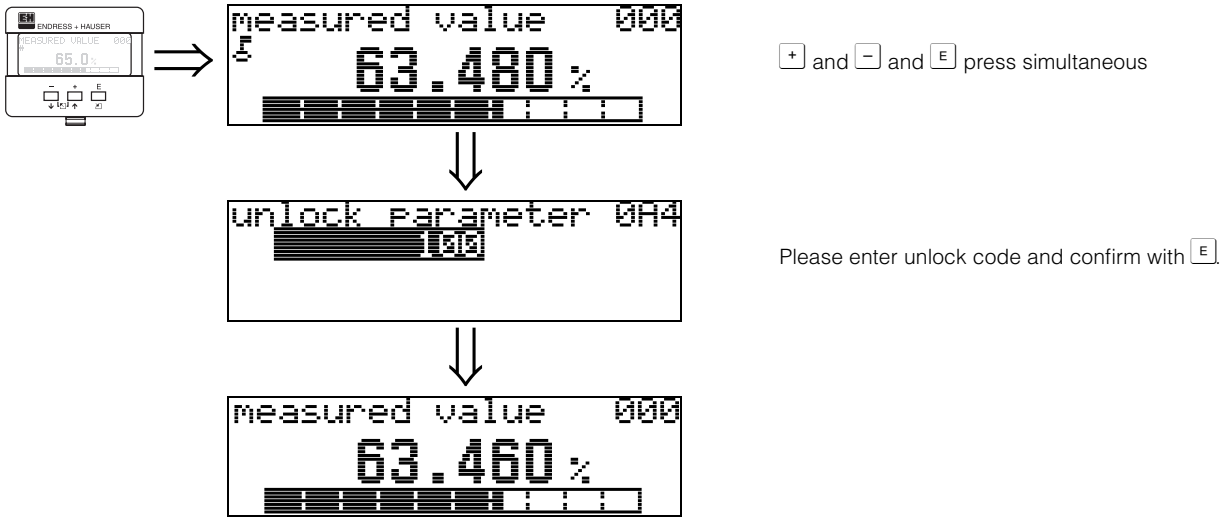
"**unlock parameter**" **(0A4):**
By entering the unlock parameter (on the display or via communication)

100 = for HART devices

the Levelflex is released for operation.

Hardware unlock:
After pressing the [+] and [−] and [E] keys at the same time, the user is asked to enter the unlock parameter

100 = for HART devices.



Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the E+H service organization. Please contact Endress+Hauser if you have any questions.

5.3.3 Factory settings (Reset)

Caution!
A reset sets the instrument back to the factory settings. This can lead to an impairment of the measurement. Generally, you should perform a basic setup again following a reset.

A reset is only necessary:
- if the instrument no longer functions
- if the instrument must be moved from one measuring point to another
- if the instrument is being de-installed /put into storage/installed

User input ("reset" (0A3)):
- 333 = customer parameters

333 = reset customer parameters
This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application:
- The Levelflex is reset to the default values.
- **The customer specific tank map is not deleted.**
- The mapping can also be deleted in the "**cust. tank map**" **(055)** function of the "**extended calibr.**" **(05)** function group.
- A linearisation is switched to "**linear**" although the table values are retained. The table can be reactivated in the "**linearisation**" **(04)** function group.

List of functions that are affected by a reset:

- tank properties (002)
- medium cond. (003)
- process proper. (004)
- empty calibr. (005)
- full calibr. (006)
- output on alarm (010)
- output on alarm (011)
- outp. echo loss (012)
- ramp %span/min (013)
- delay time (014)
- safety distance (015)
- in safety dist. (016)
- overspill protection (018)
- end of probe (030)
- level/ullage (040)
- linearisation (041)
- customer unit (042)
- max. scale (046)
- diameter vessel (047)
- check distance (051)
- range of mapping (052)
- start mapping (053)
- offset (057)
- output damping (058)
- low output limit (062)
- curr. output mode (063)
- fixed cur. value (064)
- 4mA value (068)
- language (092)
- back to home (093)
- format display (094)
- no of decimals (095)
- sep. character (096)
- unlock parameter (0A4)

A complete "**basic setup**" **(00)** must be activated.

5.4 Display and acknowledging error messages

Type of error
Errors that occur during commissioning or measuring are displayed immediately on the local display. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.
The measuring system distinguishes between two types of error:

- **A (Alarm):**
  Instrument goes into a defined state (e.g. MAX 22 mA)
  Indicated by a constant ϟ symbol.
  (For a description of the codes, see Table 9.2 on Page 72)
- **W (Warning):**
  Instrument continue measuring, error message is displayed.
  Indicated by a flashing ϟ symbol.
  (For a description of the codes, see Table 9.2 on Page 72)
- **E (Alarm / Warning):**
  Configurable (e.g. loss of echo, level within the safety distance)
  Indicated by a constant/flashing ϟ symbol.
  (For a description of the codes, see Table 9.2 on Page 72)

Error messages
Error messages appear as four lines of plain text on the display. In addition, a unique error code is also output. A description of the error codes is given on Page 72.

- The "**diagnostics (0A)**" function group can display current errors as well as the last errors that occurred.
- If several current errors occur, use ⊞ or ⊟ to page through the error messages.
- The last occurring error can be deleted in the "**diagnostics (0A)**" function group with the function"**clear last error**" **(0A2)**.

5.5 HART communication

Apart from local operation, you can also parameterise the measuring instrument and view measured values by means of a HART protocol. There are two options available for operation:
- Operation via the universal handheld operating unit, the HART Communicator DXR 275.
- Operation via the Personal Computer (PC) using the operating program (e.g. ToF Tool or Commuwin II) (For connections, see Page 33 ff.).

5.5.1 Handheld unit DXR 275

All device functions can be adjusted via menu operation with the handheld unit DXR 275.

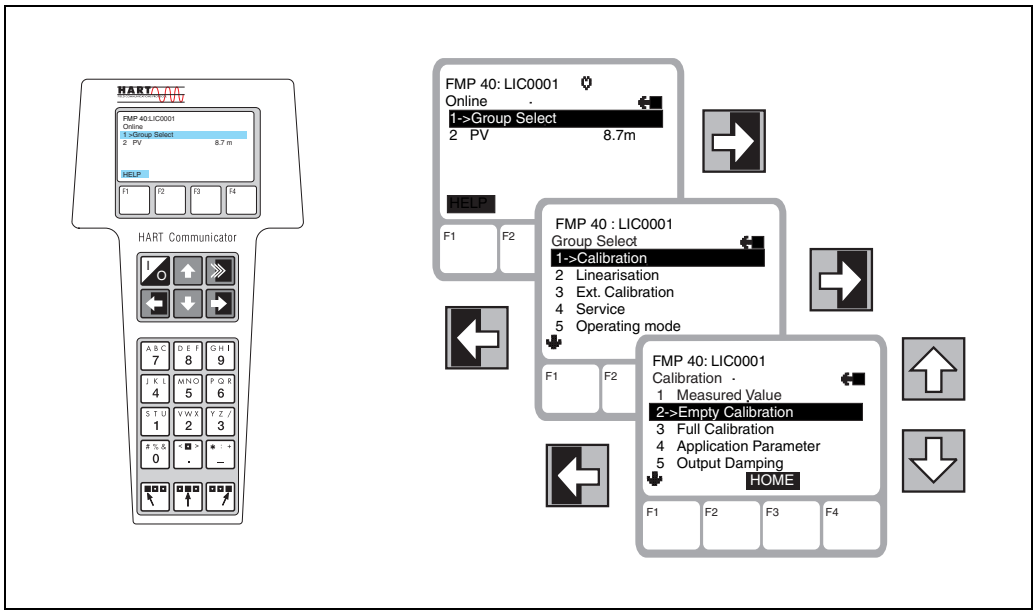


Fig. 5 Menu operation with the DXR 275 handheld instrument

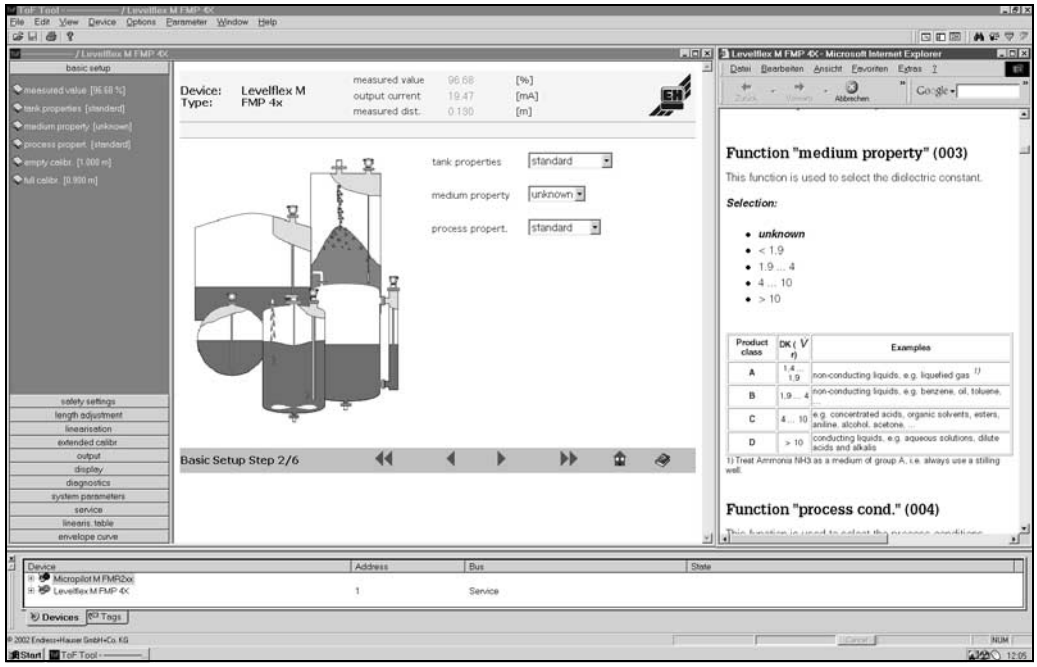
Note!
- Further information on the HART handheld unit is given in the respective operating manual included in the transport bag of the instrument.

5.5.2 ToF Tool operating program

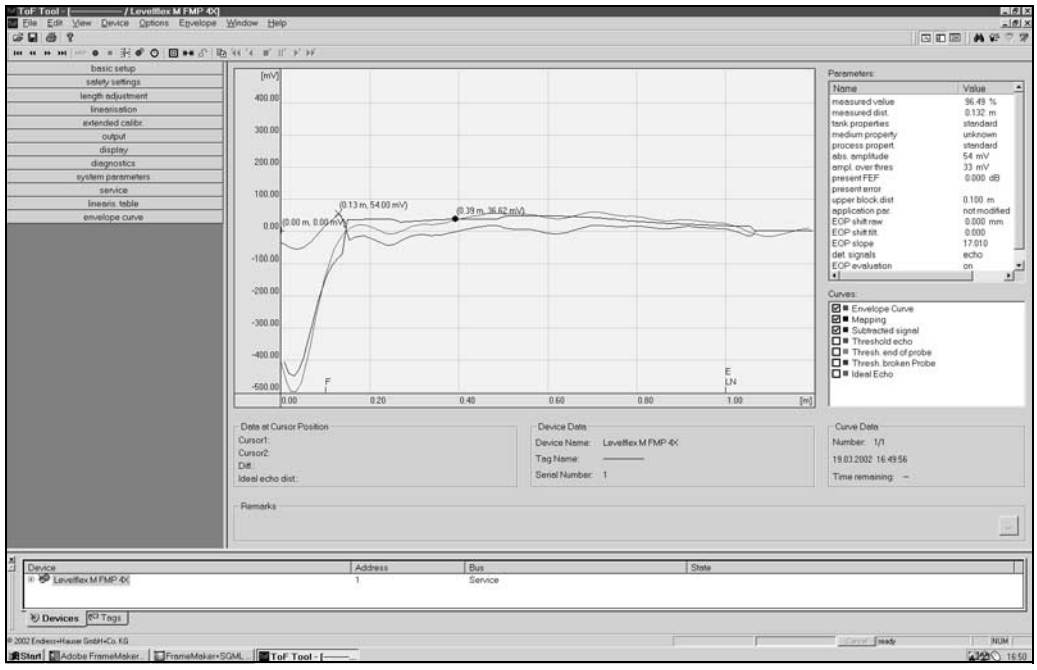
The ToF Tool is a graphical operating software for instruments from Endress+Hauser that operate based on the time-of-flight principle. It is used to support commissioning, securing of data, signal analysis and documentation of the instruments. It is compatible with the following operating systems: Win95, Win98, WinNT4.0, Win2000 and Windows XP.
The ToF Tool supports the following functions:
- Online configuration of transmitters
- Signal analysis via envelope curve
- Loading and saving of instrument data (Upload/Download)
- Documentation of measuring point

Note!
Further information you may find on the CD-ROM, which is enclosed to the instrument.

Menu-guided commissioning



Signal analysis via envelope curve:



Connection options:

- Service-interface with adapter FXA 193 (see Page 33 ff.)
- HART with Commubox FXA 191 (see Page 33 ff.)

5.5.3 Commuwin II-Operating Programm

Commuwin II is an operating software with graphical support for intelligent transmitters with the communication protocols Rackbus, Rackbus RS 485, INTENSOR, HART or PROFIBUS-PA. It is compatible with the operating systems Win 3.1/3.11, Win95, Win98 and WinNT4.0. All functions of Commuwin II are supported. The configuration is made via operating matrix or graphic surface. The envelope curve can be displayed in ToF Tool and display.

Note!
Further information on Commuwin II is given in the following E+H documentation:
- System Information: SI 018F/00/en “Commuwin II”
- Operating Manual: BA 124F/00/en “Commuwin II” operating program

Connection
The table provides an overview of the Commuwin connections.

Interface	Hardware	Server	Device list
HART	Commubox FXA 191 to HART Computer with RS-232C interface	HART	Connected instrument
	Interface FXN 672 Gateway for MODBUS, PROFIBUS, FIP, INTERBUS, etc.	ZA 673 for PROFIBUS	List of all rack bus modules: the required FXN 672 must be selected
	Computer with RS-232C interface or PROFIBUS card	ZA 672 for other	

Note!
The Levelflex M can also be operated locally using the keys. If operation is prevented by the keys being locked locally, parameter entry via communication is not possible either.

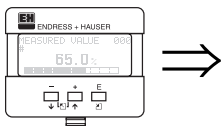
6 Commissioning

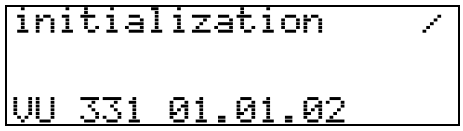
6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist “Post installation check” (see Page 28 ff.).
- Checklist “Post connection check” (see Page 34 ff.).

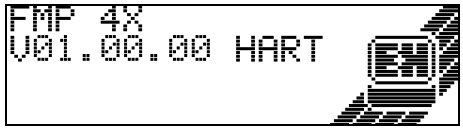
6.2 Switching on the measuring device

When the instrument is switched on for the first time, the following messages appear on the display:



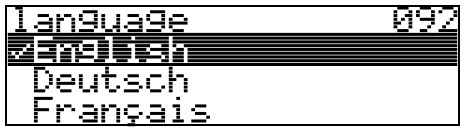


After 5 s, the following message appears

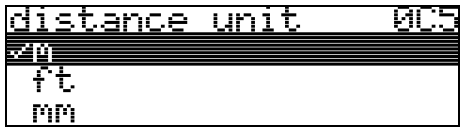


After 5 s, the following message appears (e.g. on HART devices)

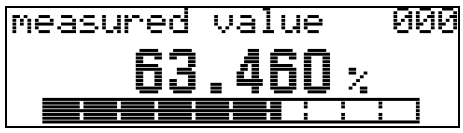
After 5 s or after you have pressed [E] the following message appears



Select the language
(this message appears the first time the instrument is switched on)



Select the basic unit
(this message appears the first time the instrument is switched on)

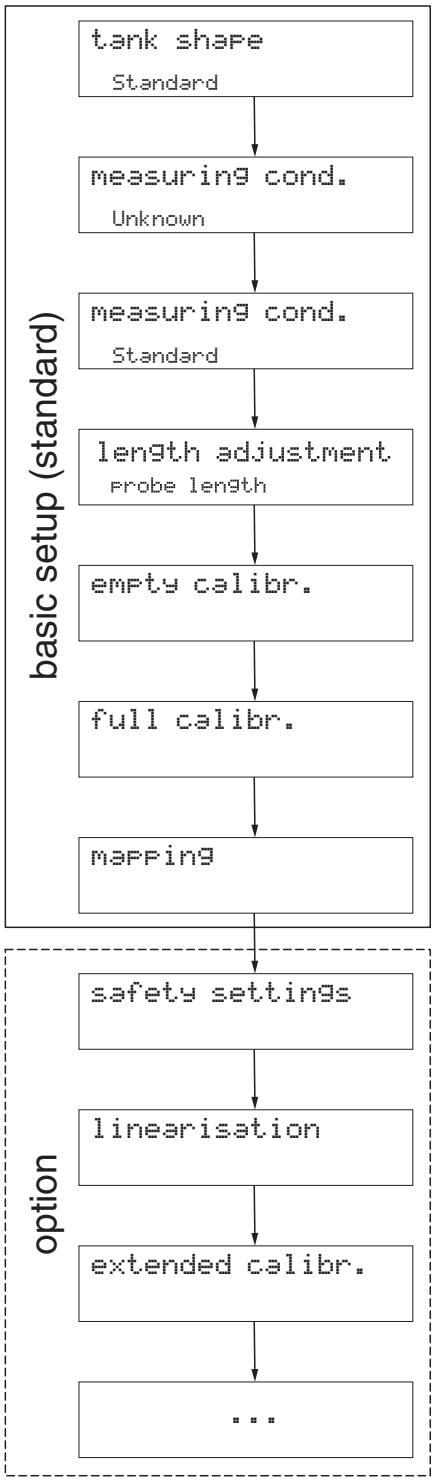


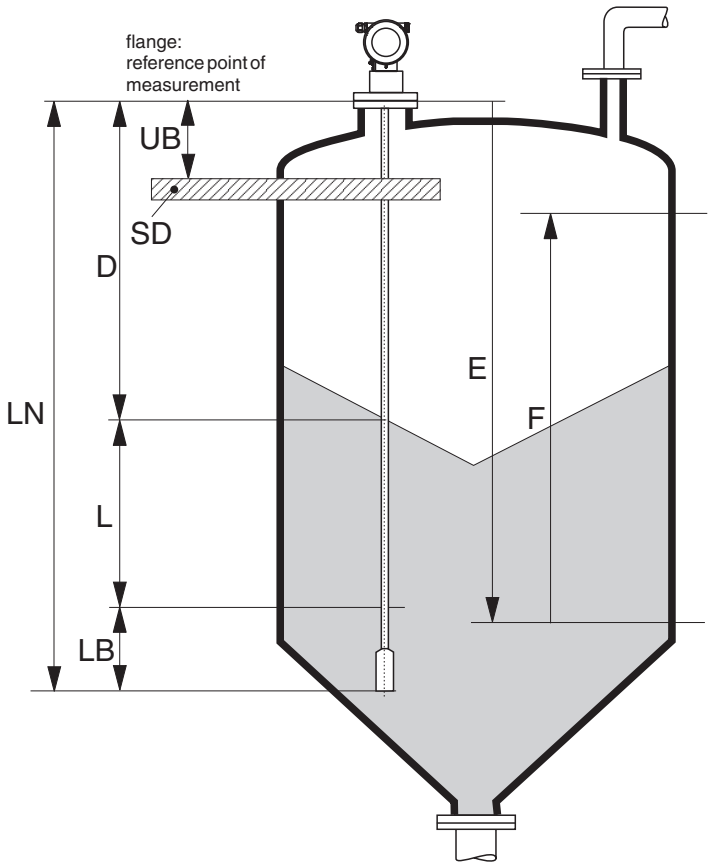
The current measured value is displayed

After [E] is pressed, you reach the group selection.

This selection enables you to perform the basic setup

6.3 Basic Setup





E = empty calibr. (= zero) setting in 005
F = full calibr. (= span) setting in 006
D = distance (distance flange / product) display in 0A5
L = level display in 0A6
LN = probe length setting in 033
UB = upper blocking distance setting in 059
SD = safety distance setting in 015
LB = lower blocking distance

The basic setup is sufficient for successful commissioning in most applications.

Note!
The Levelflex M allows to check for broken probe. On delivery, this function is switched off, because otherwise shortening of the probe would be mistaken for a broken probe. If you want to check the probe for a crack select the "**broken probe det**" **(019)** function in the "**safety settings**" **(01)** function group.

Complex measuring operations necessitate additional functions that the user can use to customise the Levelflex as necessary to suit his specific requirements. The functions available to do this are described in detail in the BA 245F.
Comply with the following instructions when configuring the functions in the **"basic setup" (00)**:
- Select the functions as described on Page 35.
- Certain functions (e.g. starting an interference echo mapping (053)) prompt you to confirm your data entries. Press [+] or [–] to select "**YES**" and press [E] to confirm. The function is now started.
- If you do not press a key during a configurable time period (→ function group "display (09)"), an automatic return is made to the home position (measured value display).

Note!
- The instrument continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the envelope curve mode is active on the display, the measured values are updated in a slower cycle time. Thus, it is advisable to leave the envelope curve mode after the measuring point has been optimised.
- If the power supply fails, all preset and parameterised values remain safely stored in the EEPROM.

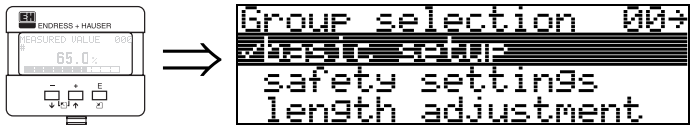
Caution!
All functions are described in detail, as is the overview of the operating menu itself, in the manual **"Description of the instrument functions – BA 245F"**, which is a separate part of this operating manual.

6.4 Basic Setup with the VU 331

Function "measured value" (000)

This function displays the current measured value in the selected unit (see "**customer unit**" **(042)** function). The number of digits after decimal point can be selected in the "**no.of decimals**" **(095)** function.

6.4.1 Function group "basic setup" (00)



Function "tank properties" (002)

This function is used to select the tank properties.

Selection:
- **standard**
- aluminium tank
- plastic tank
- bypass / pipe
- coax probe
- concrete wall

standard
The "**standard**" option is recommended for normal containers for rod and rope probes.

aluminium tank
The "**aluminium tank**" option is designed especially for high aluminium silos that cause an increased level of noise when empty. This option is only useful for probes longer than (< 4 m). For short probes (< 4 m) select the "**standard**" option.

Note!
If "**aluminium tank**" is selected, the device calibrates of its own accord when first filled, depending on the medium's properties. Slope errors can, therefore, occur when beginning the first filling procedure.

plastic tank
Select the "**plastic tank**" option when installing probes in wood or plastic containers **without** metallic surfaces at the process connection (see installation in plastic containers). When using a metallic surface at the process connection, the "**standard**" option is sufficient.

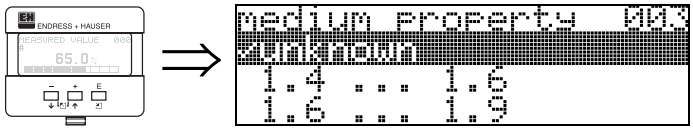
Note!
In principle the employment of a metallic surface area should be preferred at the process connection!

bypass / pipe
The "**bypass** / **pipe**" option is designed especially for the installation of probes in a bypass or a stilling well.

coax probe
Select the "**coax probe**" option when using a coaxial probe. When this setting is made, the evaluation is adapted to the high sensitivity of the coax probe. This option should, therefore, **not** be selected when using rope or rod probes.

concrete wall
The "**concrete wall**" option takes into account the signal-damping property of concrete walls when mounting with < 1 m distance to the wall.

Function "medium property" (003)



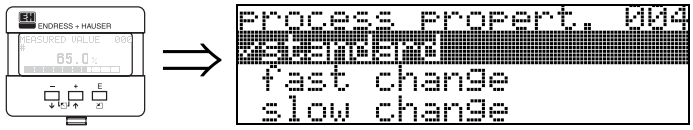
This function is used to select the dielectric constant.

Selection:
- **unknown**
- 1.4 ... 1.6 (for coaxial probe only)
- 1.6 ... 1.9
- 1.9 ... 2.5
- 2.5 ... 4.0
- 4.0 ... 7.0
- > 7.0

Media group	DK (Εr)	Typical bulk solids	Typical liquids	Typical measuring range
0	unknown			
1	1,4 … 1,6		– Liquefied gases, e.g. N_2, CO_2	4 m, coax probe only
2	1,6 … 1,9	– Plastic granules – White lime, special cement – Sugar	– Liquefied gas, e.g. propane – Solvents – Frigen / freon – Palm oil	25 m
3	1,9 … 2,5	– Portland cement, plasters	– Mineral oils, fuels	30 m
4	2,5 … 4	– Cereals, seeds – Ground stone – Sand	– Benzene, styrene, toluene – Furan – Naphthalene	35 m
5	4 … 7	– Naturally-moist (ground) stone, ores – Salt	– Chlorobenzene, chloroform – Cellulose spray – Isocyanate, aniline	35 m
6	> 7	– Metal powder	– Aqueous solutions – Alcohols – Ammoniac	35 m

The lower group applies to very loose or loosened bulk solids.
Reduction of the max. possible measuring range by means of:
- extremely loose surfaces of bulk solids, e.g. bulk solids with low piled density when filled pneumatically.
- Build-up, primarily of moist products.

Function "process propert." (004)

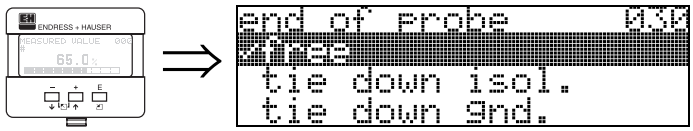


Use this function to adapt the device reaction to the filling speed in the tank. The setting impacts on an intelligent filter.

Selection:
- **standard**
- fast change
- slow change
- test:no filter

Selection:	standard	fast change	slow change	test:no filter
Application:	For all normal applications, bulk solids and fluids at low to medium filling speed and sufficiently large tanks.	Small tanks, primarily with fluids, at high filling speeds.	Applications with strong surface movement, e.g. caused by stirrer, primarily large tanks with slow to medium filling speed.	Shortest reaction time: • For test purposes • Measurement in small tanks at high filling speeds, if "rapid change" setting is too slow.
2-wire electronics:	Dead time: 4 s Rise time: 18 s	Dead time: 2 s Rise time: 5 s	Dead time: 6 s Rise time: 40 s	Dead time: 1 s Rise time: 0 s
4-wire electronics:	Dead time: 2 s Rise time: 11 s	Dead time: 1 s Rise time: 3 s	Dead time: 3 s Rise time: 25 s	Dead time: 0,7 s Rise time: 0 s

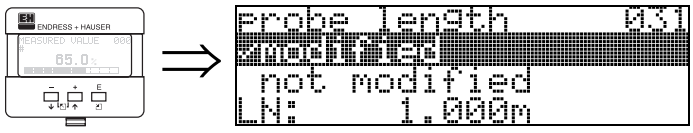
Function "end of probe" (030)



Use this function to select the polarity of the probe end signal. If the probe end is uncovered or in an insulated attachment, there is a negative probe end signal. The signal from the probe end is positive if the attachment is grounded.

Selection:
- **free**
- tie down isol.
- tie down gnd.

Function "probe length" (031)

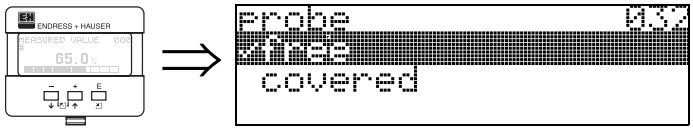


Use this function to select whether the probe length was changed after factory calibration. Only then is it necessary to enter or correct the probe length.

Selection:
- **not modified**
- modified

Note!
If "modified" was selected in the "**probe length**" **(031)** function, the probe length is defined in the next step.

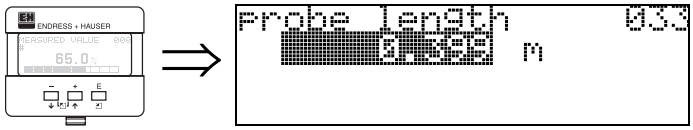
Function "probe" (032)



Use this function to select whether the probe is at the time of the commisioning uncovered or covered.
If the probe is uncovered, the Levelflex can determine the probe length automatically "**determine length**" (**034**). function. If the probe is covered, a correct entry is required in the "**probe length**" **(033)** function

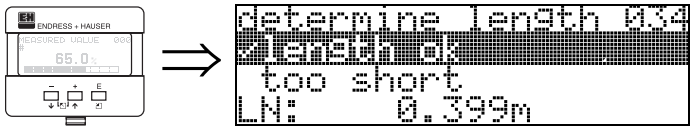
Selection:
- **free**
- covered

Function "probe length" (033)



Use this function, the probe length can be entered manually.

Function "determine length" (034)

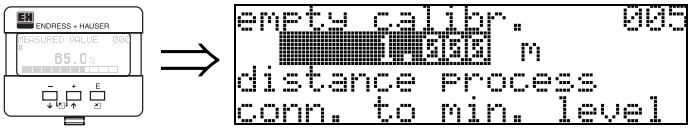


Use this function, the probe length can be determined automatically.

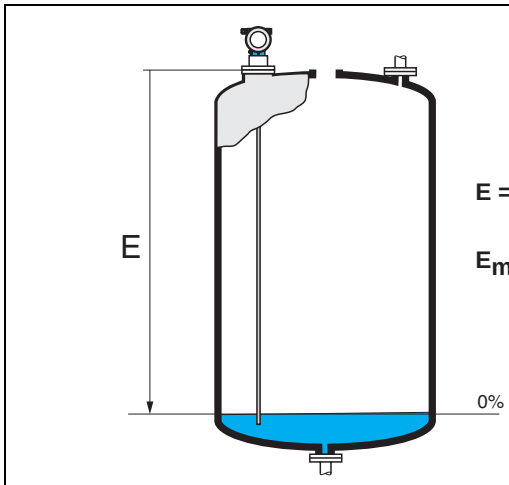
Selection:
- **length ok**
- too short
- too long

After selection "length too short" or "length too long", the calculation of the new value need approx. 10 s.

Function "empty calibr." (005)



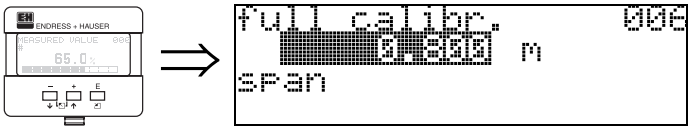
This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (=zero).



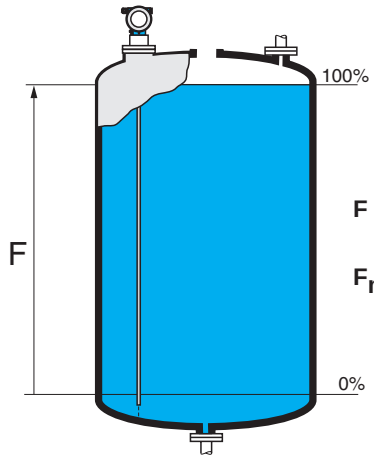
E = empty calibration (= zero)

E_{max} = probe length – lower blocking distance

Function "full calibr." (006)



This function is used to enter the distance from the minimum level to the maximum level (=span).



F = full calibration (= span)

F_{max} = E – upper blocking distance

Note!
The usable measuring range lies between the lower and the upper blocking distance. The values for empty distance (E) and span (F) can be set independently of this.

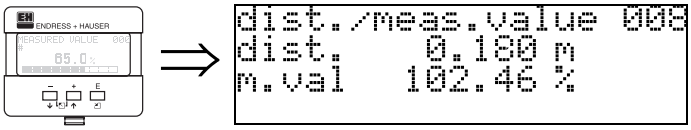
Blocking distance and measuring range for Dk ≥ 1.6 (1.4 for coax probes):

FMP 40	LN [m]/"		UB [m]/"	LB [m]/"
	min	max	min	min
Rope probe	1/40	35/1378	0,2/8 [1)]	0,25/10
6 mm rod probe	0,3/12	2/80	0,2/8 [1)]	0,05/2
16 mm rod probe	0,3/12	4/178	0,2/8 [1)]	0,05/2
Coax probe	0,3/12	4/178	0/0	0,05/2

1) The indicated blocking distances are prearised. At media with DK >7, the upper blocking distance UB can be reduced for rod- and rope probes on 0.1m. The upper blocking distance UB can be entered manually.

Note!
Within the upper and lower blocking distance, a reliable measurement can not be guaranteed.

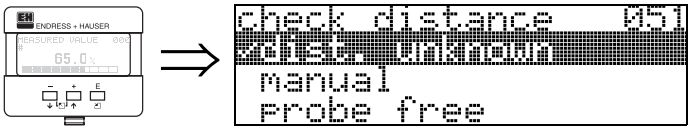
Display (008)



The **distance** measured from the reference point to the product surface and the **meas. value** calculated with the aid of the empty adjustment are displayed. Check whether the values correspond to the actual meas. value or the actual distance. The following cases can occur:

- Distance correct – meas. value correct -> continue with the next function, "**check distance**" **(051)**
- Distance correct – meas. value incorrect -> Check "**empty calibr.**" **(005)**
- Distance incorrect – meas. value incorrect -> continue with the next function, "**check distance**" **(051)**

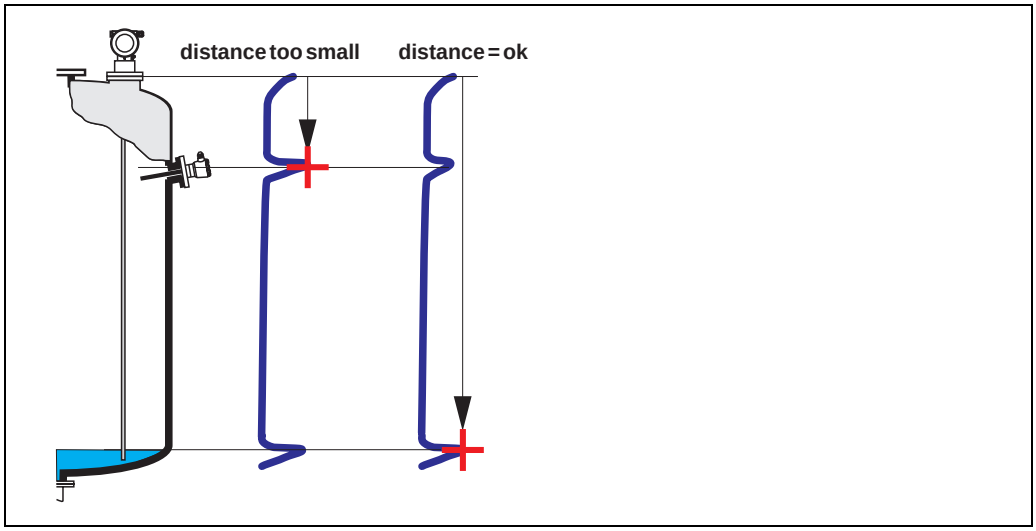
Function "check distance" (051)



This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

Selection:

- distance = ok
- dist. too small
- dist. too big
- dist. unknown
- **manual**
- probe free



distance = ok

Use this function at part-covered probe. Choosing function "**manual**" or "**probe free**" at free probe.

- mapping is carried out up to the currently measured echo
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

Anyway, it is wise to carry out a mapping even in this case.

Note!

At free probe, the mapping should be confirmed with the choice "**probe free**".

dist. too small
- At the moment, an interference is being evaluated
- Therefore, a mapping is carried out including the presently measured echoes
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

dist. too big
- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002), (003), (004)** and "**probe length.**" **(031)**

dist. unknown
If the actual distance is not known, no mapping can be carried out.

manual
A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the "**range of mapping (052)**" function.

Caution!
The range of mapping must end 0.3 m (20") before the echo of the actual level. In case of empty vessel it is possible to make a map over the whole probe length.

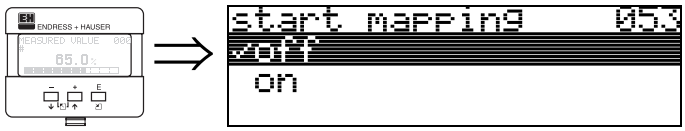
probe free
If the probe is uncovered, mapping is carried out along the whole probe length.

Caution!
Only begin mapping in this function if the probe is safely uncovered. Otherwise, the device will not make correct measurements.

Function "range of mapping" (052)

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (see Page 47 ff.). This value can be edited by the operator.
For manual mapping, the default value is 0,3 m.

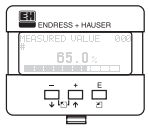
Function "start mapping" (053)

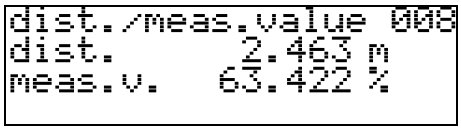


This function is used to start the interference echo mapping up to the distance given in "**range of mapping**" **(052)**.

Selection:
- **off**: no mapping is carried out
- on: mapping is started

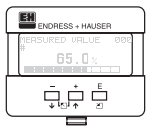
Display (008)

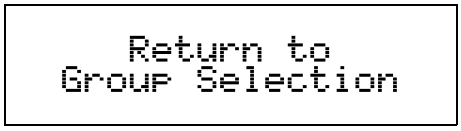




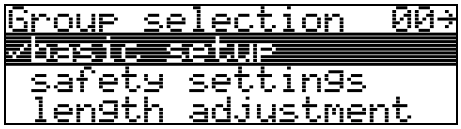
The distance measured from the reference point to the product surface and the meas. value calculated with the aid of the empty alignment are displayed again. Check whether the values correspond to the actual meas. value or the actual distance. The following cases can occur:

- Distance correct – meas. value correct -> basic setup completed
- Distance incorrect – meas. value incorrect -> a further interference echo mapping must be carried out "**check distance**" (**051)**.
- Distance correct – meas. value incorrect -> check "**empty calibr.**" **(005)**





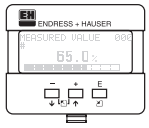
After 3 s, the following message appears



Note!
After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**envelope curve**" **(0E)**" function group) is recommended (see page 89).

6.5 Blocking distnace

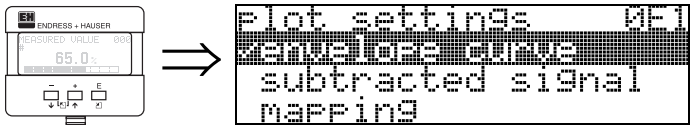
Note!
At installation in high nozzles, please the blocking distance in the function "**upper block.dist**" **(059)** newly enter!



6.5.1 Envelope curve with VU 331

After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**envelope curve**" **(0E)** function group) is recommended.).

6.5.2 Function "plot settings" (0E1)



Here you can select which information is shown on the display:
- **envelope curve**
- substracted signal
- mapping

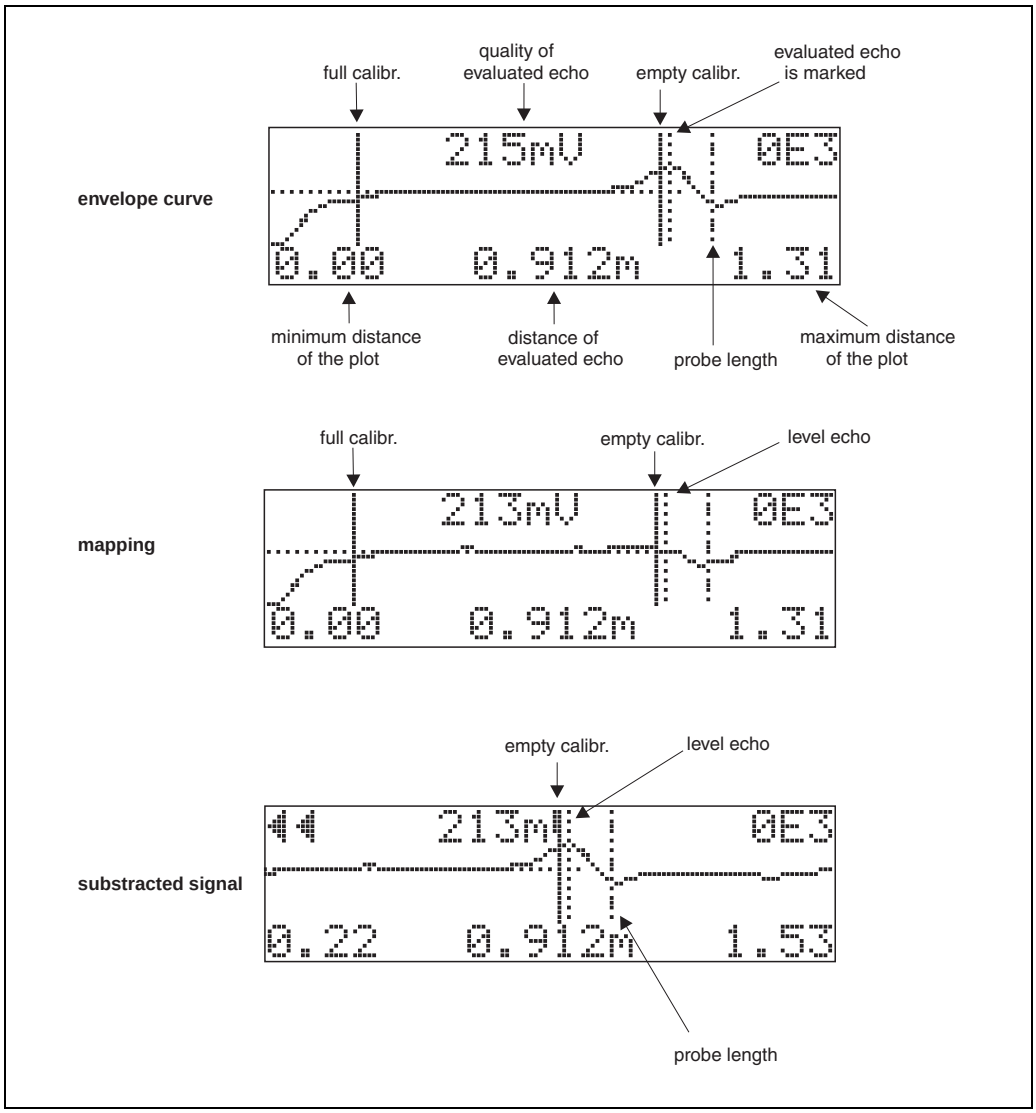
6.5.3 Function "recording curve" (0E2)

Function "recording curve" (09B)
This function determines whether the envelope curve is read as:
- **single curve**
  or
- cyclic.

Note!
If the envelope curve mode is active on the display, the measured values are updated in a slower cycle time. Thus, it is advisable to leave the envelope curve mode after the measuring point has been optimised.

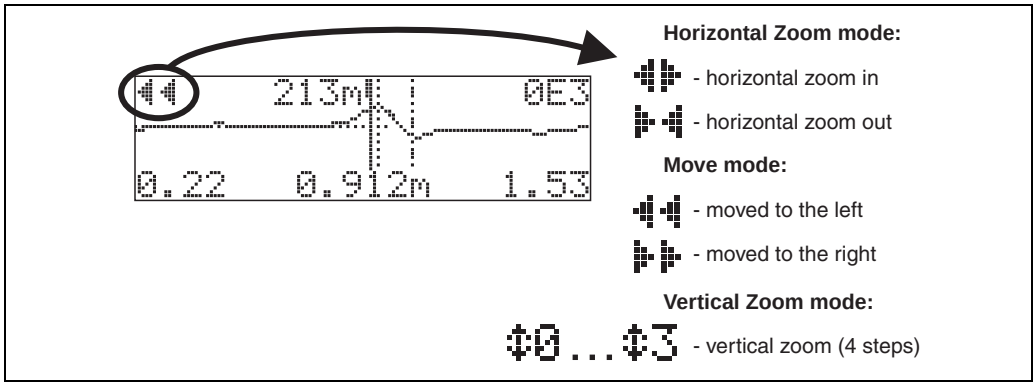
6.6 Function "envelope curve display" (0E3)

You can obtain the following information from the envelope curve display in this function:

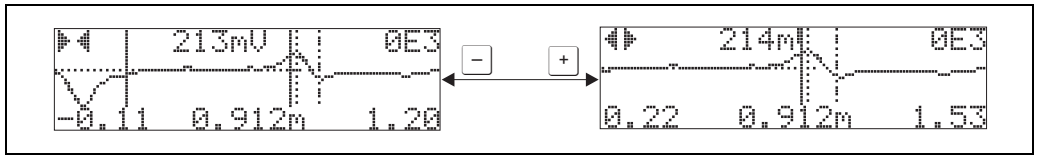


Navigation in the envelope curve display

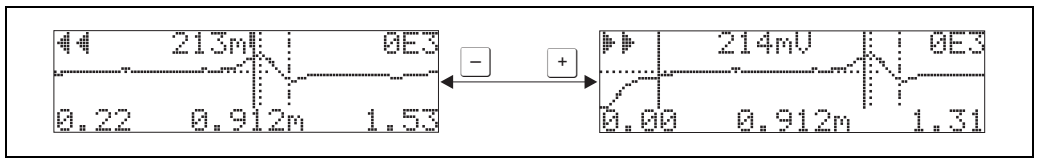
Using navigation, the envelope curve can be scaled horizontally and vertically and shifted to the left or the right. The active navigation mode is indicated by a symbol in the top left hand corner of the display.



Horizontal-Zoom-Modus
Press [+] or [−], to switch to the envelope curve navigation. You are then in Horizontal Zoom mode. Either ⇹ or ⇹ is displayed.
You now have the following options:
- [+] increases the horizontal scale.
- [−] decreases the horizontal scale.

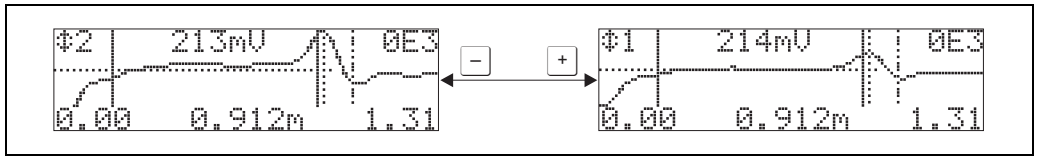


Move-Modus
Then press [E], to switch to Move mode. Either ⇹ or ⇹ is displayed.
You now have the following options:
- [+] shifts the curve to the right.
- [−] shifts the curve to the left.

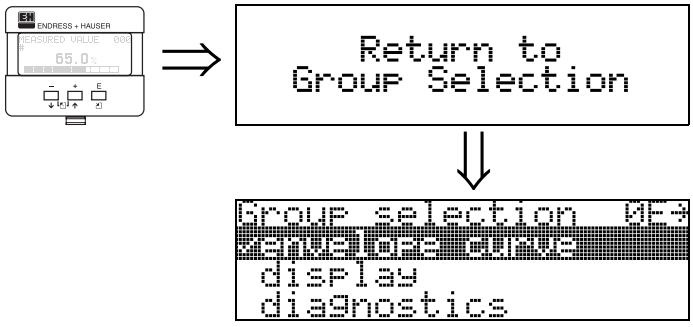


Vertical-Zoom-Modus
Press [E], once more to switch to Vertical Zoom mode ⇳1 is displayed.
You now have the following options:
- [+] increases the vertical scale.
- [−] decreases the vertical scale.

The display icon shows the current zoom factor (⇳0 to ⇳3).



Exiting the navigation
- Press [E] again to run through the different modes of the envelope curve navigation.
- Press [+] and [−] to exit the navigation. The set increases and shifts are retained. Only when you reactivate the **"recording curve" (0E2)** function does the Levelflex use the standard display again.



After 3 s, the following message appears

6.7 Basic Setup with the ToF Tool

To carry out the basic setup with the ToF Tool operating program, proceed as follows:
- Start the ToF Tool operating program and establish a connection
- Select the "**basic setup**" function group in the navigation bar

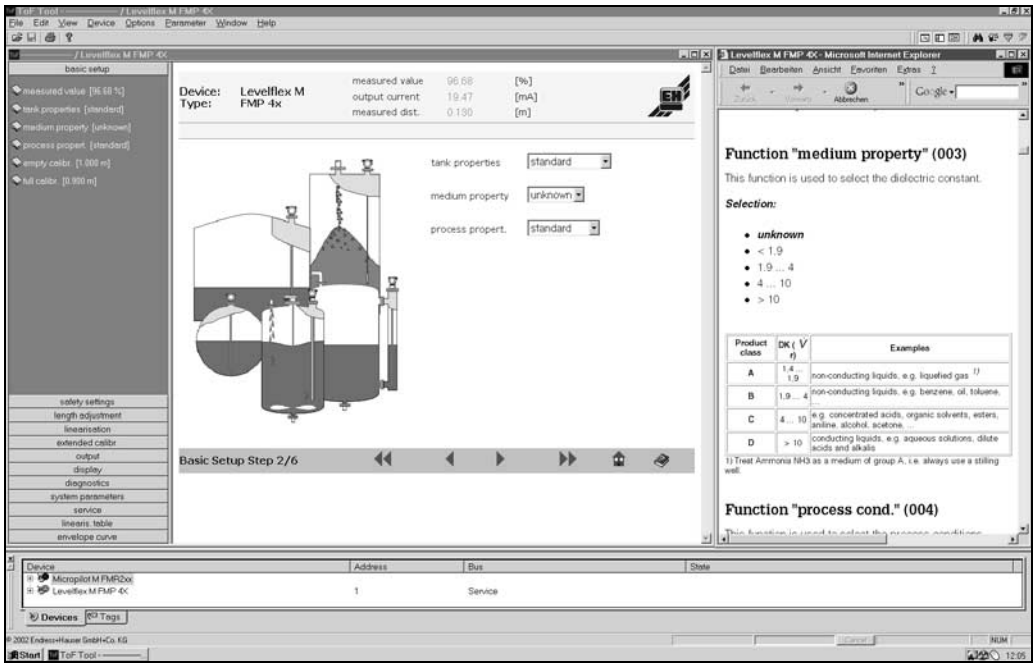
The following display appears on the screen:

Basic Setup step 1/6:
- Status image
- Enter the measuring point description (TAG number).

Note!
- Each parameter that is changed must be confirmed with the **RETURN** key!
- The "**Next**" button moves you to the next screen display:

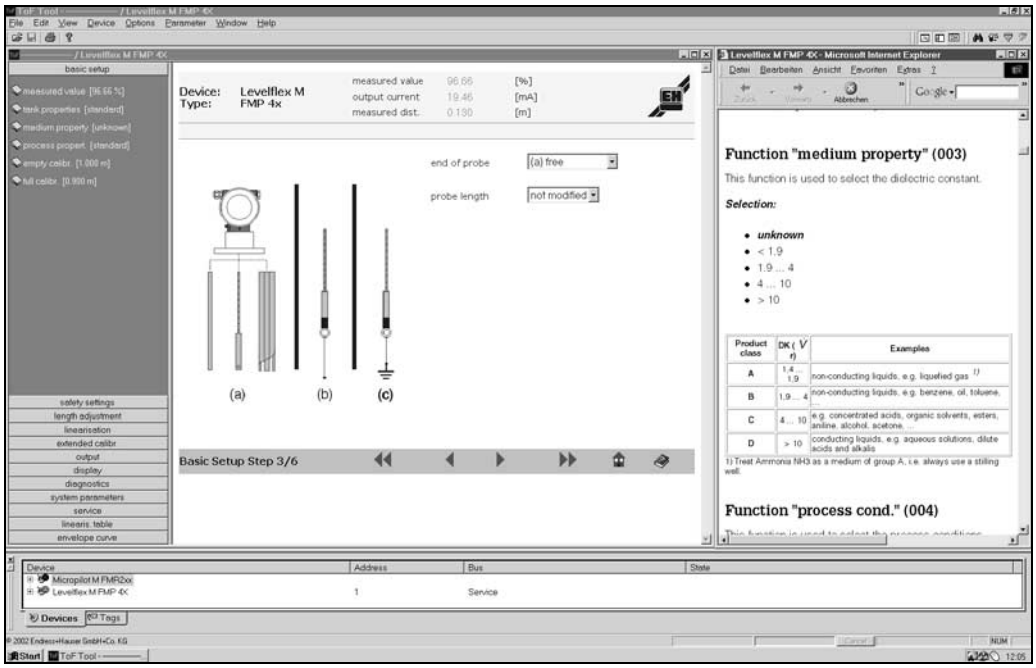
Basic Setup step 2/5:

- Enter the application parameters:
  – tank properties (for a description, see page 49)
  – medium properties (for a description, see page 50)
  – process properties(for a description, see page 51)



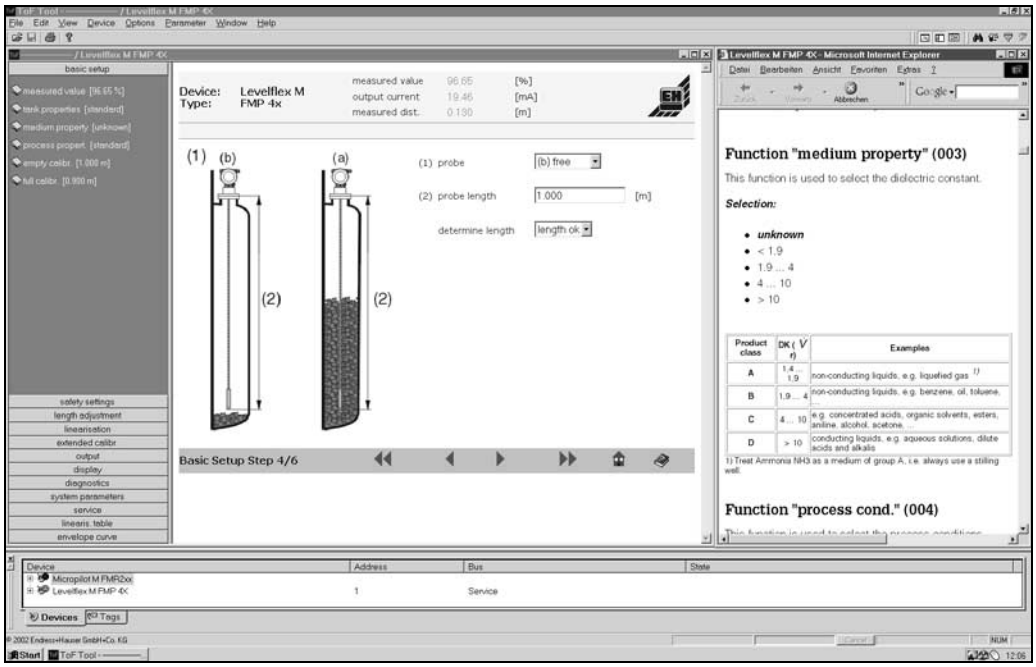
Basic Setup step 3/6:

- Enter the application parameters:
  – end of probe (for a description, see page 51)
  – probe length (for a description, see page 52)



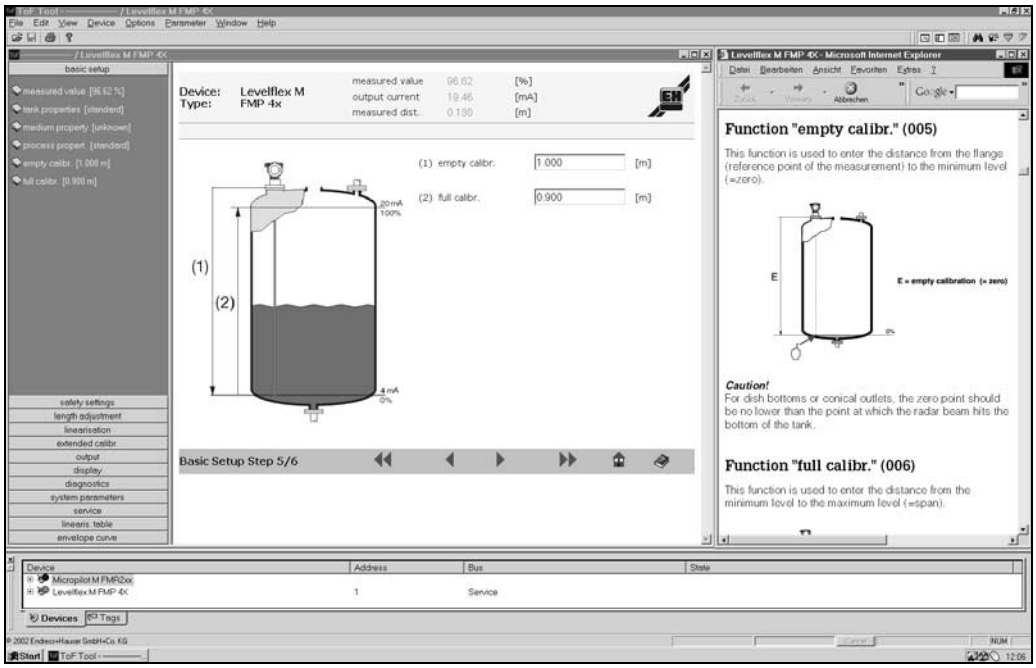
Basic Setup step 4/6:

- Enter the application parameters:
  – probe (for a description, see page 52)
  – probe length (for a description, see page 52)
  – determine length (for a description, see page 52)

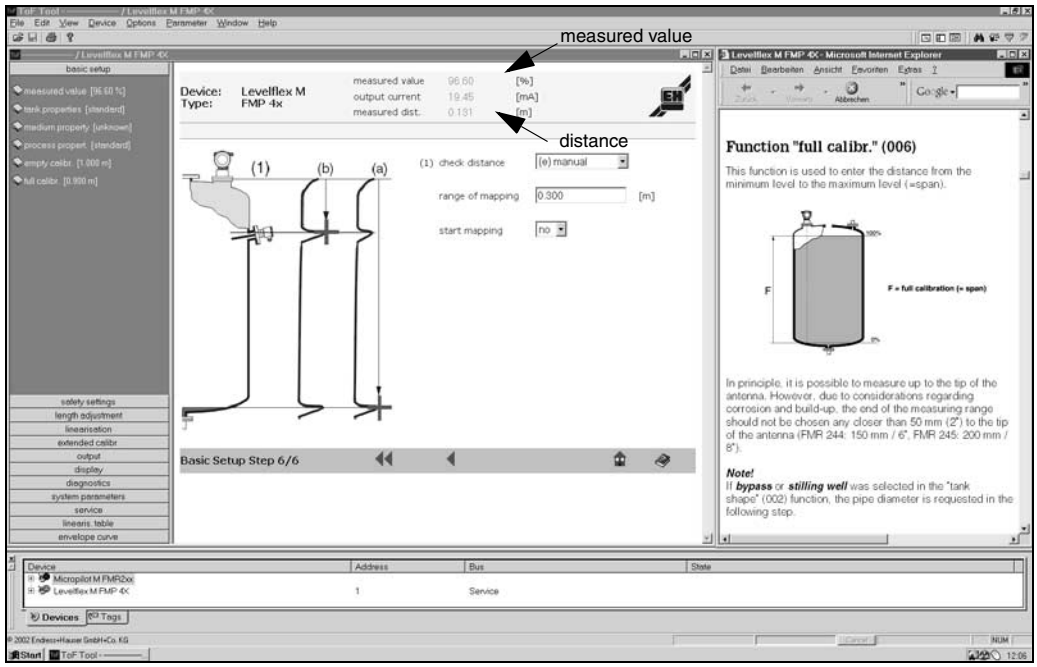


Basic Setup step 5/6:

- Enter the application parameters:
  – empty calibration (for a description, see page 53)
  – full calibration (for a description, see page 53)



Basic Setup step 6/6:
- This step starts the tank mapping
- The measured distance and the current measured value are always displayed in the header
- for a description, see page 55

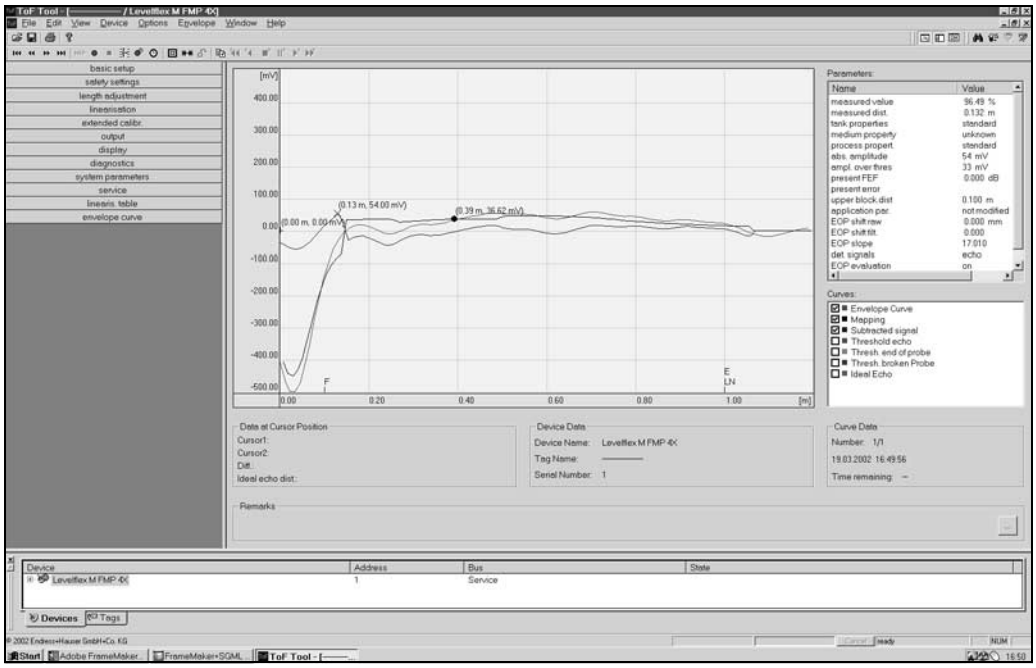


6.7.1 Blocking distance

Note!
At installation in high nozzles, please the blocking distance in the function "**upper block.dist**" **(059)** newly enter!

6.7.2 Envelope curve with the ToF Tool

After the basic setup, an evaluation of the measurement using the envelope curve is recommended (see page 89).



Note!
For the optimization of the measurement the installation of the Levelflex in another place can be executed when enterference echoes.

6.7.3 User-specific applications (operation)

For details of setting the parameters of user-specific applications, see separate documentation BA 245F/00/en - description of the instrument functions of the Levelflex M.

7 Maintenance

The Levelflex M measuring instrument requires no special maintenance.

Exterior cleaning
When cleaning the Levelflex M , always use cleaning agents that do not attack the surface of the housing and the seals.

Repairs
The Endress+Hauser repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves. Spare parts are contained in suitable kits. They contain the related replacement instructions. All the spare parts kits which you can order from Endress+Hauser for repairs to the Levelflex M are listed with their order numbers on pages 76 and 77.
Please contact Endress+Hauser Service for further information on service and spare parts.

Repairs to Ex-approved devices
When carrying out repairs to Ex-approved devices, please note the following:
- Repairs to Ex-approved devices may only be carried out by trained personnel or by Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry our the specified routine test on the device.
- Only Endress+Hauser Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

Replacement
After a complete Levelflex M or electronic module has been replaced, the parameters can be downloaded into the instrument again via the communication interface. Prerequisite to this is that the data were uploaded to the PC beforehand using the ToF Tool / Commuwin II.
Measurement can continue without having to carry out a new setup.

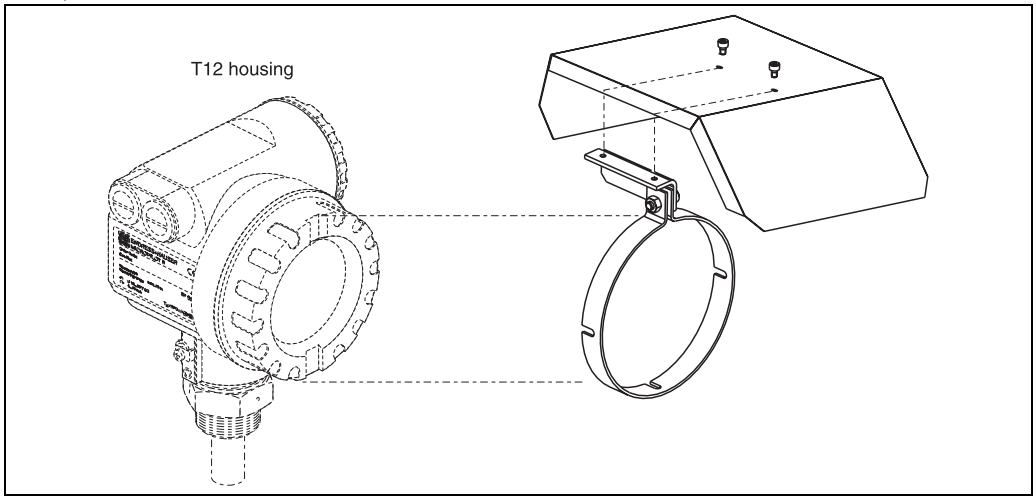
- You may have to activate linearisation (see BA 221F)
- You may need to record the tank map again (see Basic Setup)

After an probe or electronic has been replaced, a new calibration must be carried out. This is described in the repair instructions.

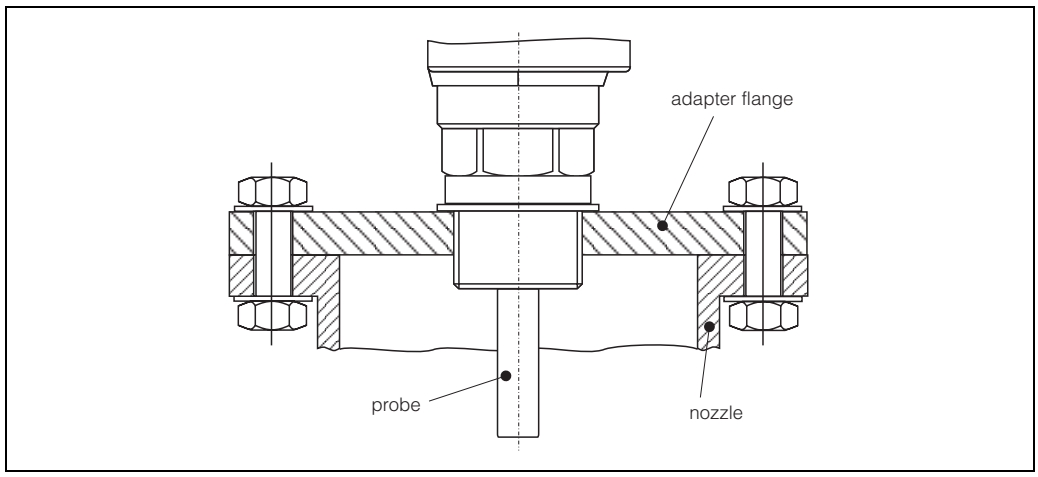
8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the Levelflex M.

Weather protection cover
A Weather protection cover made of stainless steel is available for outdoor mounting (order code: 543199-0001). The shipment includes the protective cover and tension clamp.



Adapter flange FAU 70 E/FAU 70 A



	Version
12	DN 50 PN 16
14	DN 80 PN 16
15	DN 100 PN 16

	Thread
3	G 1½, ISO 228

	Material
2	1.4435

FAU 70 E -				Complete product designation

	Version
12	ANSI 2" 150 psi
14	ANSI 3" 150 psi
15	ANSI 4" 150 psi

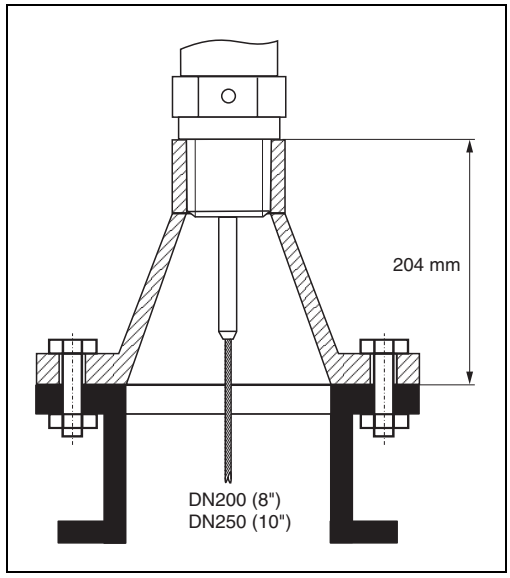
	thread
3	NPT 1½ - 11,5

	Material
2	1.4435

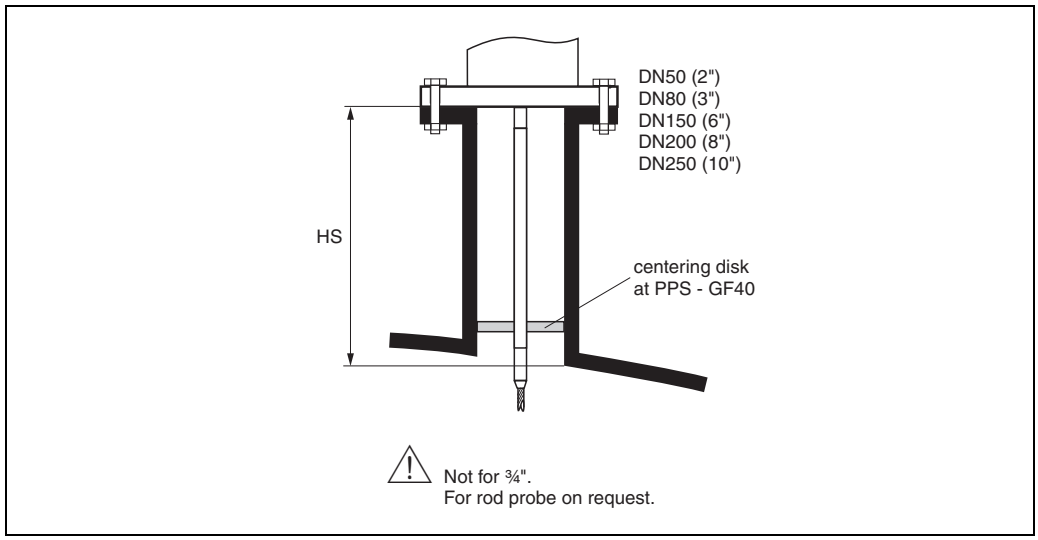
FAU 70 A -				Complete product designation

Flange with horn adapter to adapt on the following nozzles

	Order - No.
G 1 1/2" at DN 200 / PN 16	52014251
G 1 1/2" at DN 250 / PN 16	52014252
NPT 1 1/2" at 8" / 150 psi	52014253
NPT 1 1/2" at 10" / 150 psi	52014254



Extension rod / Centering



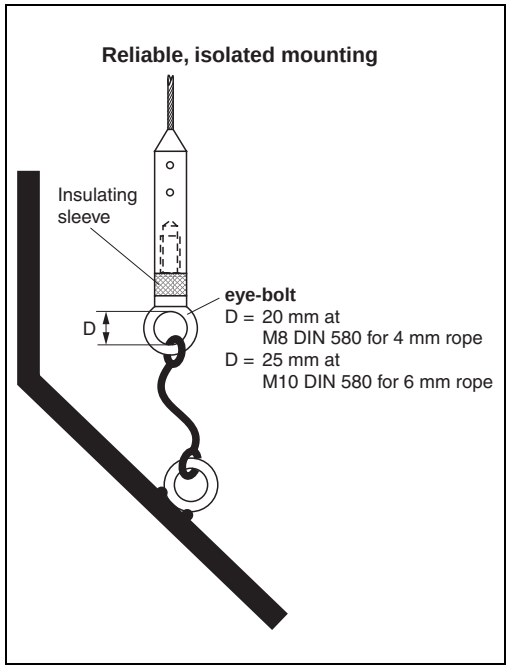
	Certificate				
	A				For non-hazardous areas
	2				ATEX II 1D
		Extension rod			
		1			115mm-rod for nozzle height 150...250mm / 6...10"
		2			215mm-rod for nozzle height 250...350mm / 10...14"
		3			315mm-rod for nozzle height 350...450mm / 14...18"
		4			415mm-rod for nozzle height 450...550mm / 14...22"
		9			Special version
			Centre disk		
			A		without centre disk
			B		DN40 / 1 1/2", inside diam. 40-45mm
			C		DN50 / 2", inside diam. 50...57mm
			D		DN80, inside diam. 80...85mm
			E		3", inside diam. 76...78mm
			G		DN100 / 4", inside diam. 100...110mm
			H		DN150 / 6", inside diam. 152...164mm
			J		DN200 / 8", inside diam. 201...215mm
			K		DN250 / 10", inside diam. 253...269mm
			Y		Special version
HMP40-					complete product designation

Isolated tie down

	Order - No.
for 4mm rope probe	52014249
for 6mm rope probe	52014250

If a rope probe has to be fixed and a secure grounded mounting is not possible, we recommend using the insulating sleeve made of PEEK-GF30 with accompanying DIN 580 eye-bolt made of stainless steel.
Max. process temp. 150 °C.

Due to the risk of electrostatic charge, the insulating sleeve is not suitable for use in hazardous areas.
In these cases the fixing must be reliably grounded (see page 23).

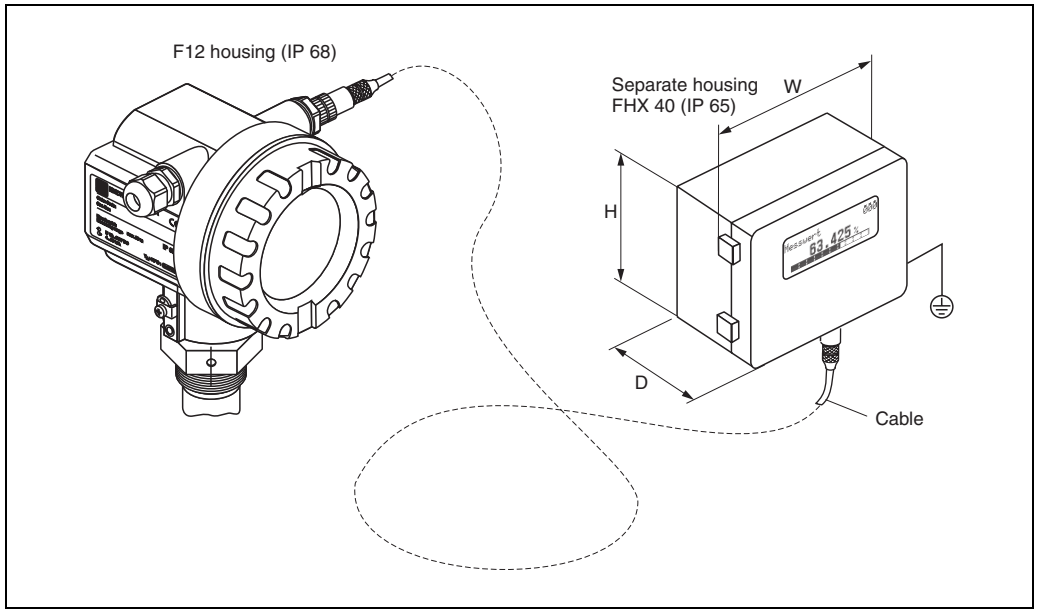


Commubox FXA 191 HART
For intrinsically safe communication with ToF Tool or Commuwin II via the RS 232C-interface.

Service adapter FXA 193
For communication with ToF Tool via the display connector. (Bestell-Nr.: 50095566).

Commuwin II
Operating software for intelligent instruments.

Remote display FHX 40
Dimensions



Technical data:

Max. cable length:	20 m (67 ft)
Temperature range:	-30 °C...+70 °C (-22 °F...158 °F)

Separate housing:

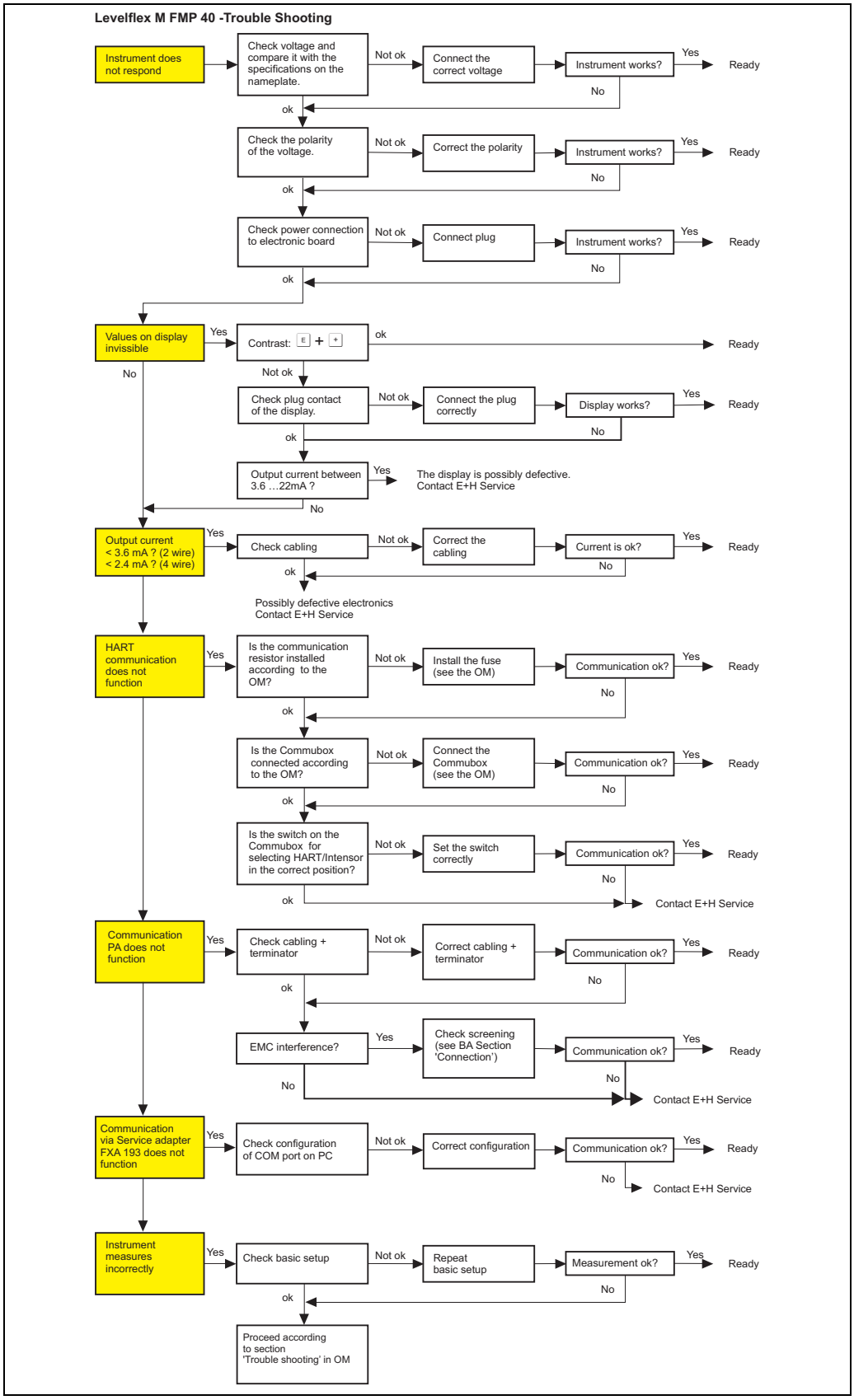
Degree of protection:	IP65 acc. to EN 60529 (NEMA 4)
Material for housing:	Alloy of Aluminium AL Si 12
Dimensions [mm] / [inch]:	122x150x80 (HxBxT) / 4.8x5.9x3.2

EMC version with conductive sealing

Also suitable for use in zone 1, in combination with a Levelflex M with ATEX II 1/2 G EEx ia IIC T6 approval.

9 Trouble-shooting

9.1 Trouble-shooting instructions



9.2 System error messages

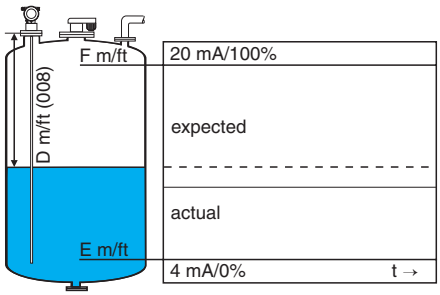
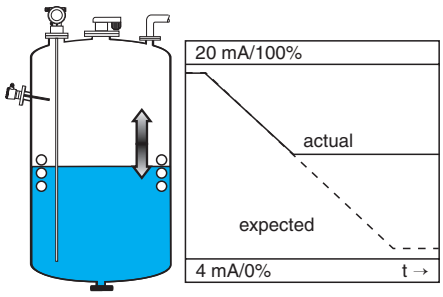
Code	Description	Possible cause	Remedy
A102	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
W103	initialising - please wait	E²PROM storage not yet finished	wait some seconds; if warning prevails, exchange electronics
A106	downloading please wait	processing data download	wait until warning disappears
A110	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A111	electronics defect	RAM defective	reset; if alarm prevails after reset, exchange electronics
A113	electronics defect	ROM defective	reset; if alarm prevails after reset, exchange electronics
A114	electronics defect	E2PROM defective	reset; if alarm prevails after reset, exchange electronics
A115	electronics defect	general hardware problem	reset; if alarm prevails after reset, exchange electronics
A116	download error repeat download	checksum of stored data not correct	restart download of data
A121	electronics defect	no factory calibration existant; E²PROM defective	contact service
W153	initialising - please wait	initialisation of electronics	wait some seconds; if warning prevails, power off device and power on again
A160	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A164	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A171	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A221	Probe pulse deviation from average values	HF module or cable between HF module and electronics defective	Check contacts on HF module If fault cannot be eliminated: Replace HF module

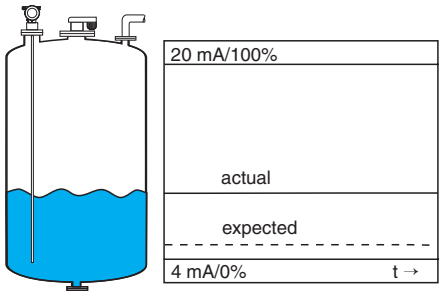
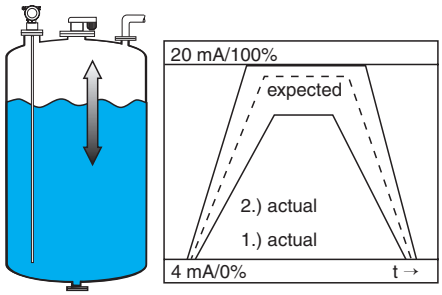
Tab. 3 System error messages

Code	Description	Possible cause	Remedy
A241	Broken probe	Broken probe or value for probe length is too short	Check the probe length in 033, Check the probe itself, if the probe is broken, change the probe, or change to a non contact system
A251	Feedthrough	Lost contact in the process feedthrough	Replace process feedtrough
A261	HF cable defective	HF cable defective or HF connector removed	Check HF connector, replace cable if defective
A275	Offset too high	Temperature at the electronics too high or HF module defective	Check temperature, replace HF module if defective
A512	recording of mapping please wait	mapping active	wait some seconds until alarm disappears
W601	linearisation ch1 curve not monotone	linearization not monotonously increasing	correct linearisation table
W611	less than 2 linearisation points for channel 1	number of entered linearization points < 2	correct linearisation table
W621	simulation ch. 1 on	simulation mode is active	switch off simulation mode
E641	no usable echo channel 1 check calibr.	echo lost due to application conditions of built up on antenna	check installation; clean antenna (cf. Operating Instructions)
W650	Signal/noise ratio too low or no echo	noise on signal to high	eliminate electromagnetic interference
E651	level in safety distance - risk of overspill	level in safety distance	alarm will disappear as soon as level leaves safety distance;
A671	linearisation ch1 not complete, not usable	linearisation table is in edit mode	activate linearisation table
W681	current ch1 out of range	current out of range (3,8 mA ... 21,5 mA)	check calibration and linearisation

Tab. 3 System error messages

9.3 Application errors

Error	Output	Possible cause		Remedy
A warning or alarm has occurred.	Depending on the configuration	See table of error messages (see page 72)		1. See table of error messages (see page 72)
Measured value (00) is incorrect		Measured distance (008) OK?	yes →	1. Check empty calibr. (005) and full calibr. (006). 2. Check linearisation: → level/ullage (040) → max. scale (046) → diameter vessel (047) → Check table
		no ↓		
		An interference echo may have been evaluated.	yes →	1. Carry out tank mapping → basic setup
No change off measured value on filling/emptying		Interference echo from installations, nozzle or extension on the antenna		1. Carry out tank mapping → basic setup 2. If necessary, clean probe. 3. If necessary, select better mounting position
E 641 (loss of echo) after turn on the power supply	**If the instrument is configured to Hold by loss of echo the output is set to any value/current.**	noise level during the initialisation phase to high.		Repeat once more empty calibr. (005). Caution! Before conformation change with ⊞ or ⊟ to the edit mode.

Device displays a level when the tank is empty.		Incorrect probe length	1. Carry out automatic probe length detection when the tank is empty. 2. Carry out mapping over entire probe when the tank is empty (probe free).
Measured value incorrect (slope error in the entire measuring range)		Tank properties incorrect. Medium properties incorrect.	LN < 4 m and "Aluminium tank" tank properties selected → Calibration not possible. → Selection → Select standard → Thresholds too high Select lower medium properties.

9.4 Spare parts

Note!
You can order spare parts directly from your E+H service organization by giving the serial number which is printed on the measuring transducer nameplate (see Page 6 ff.). The corresponding spare part number also appears on each spare part. Installation instructions are given on the instruction card that is also delivered.

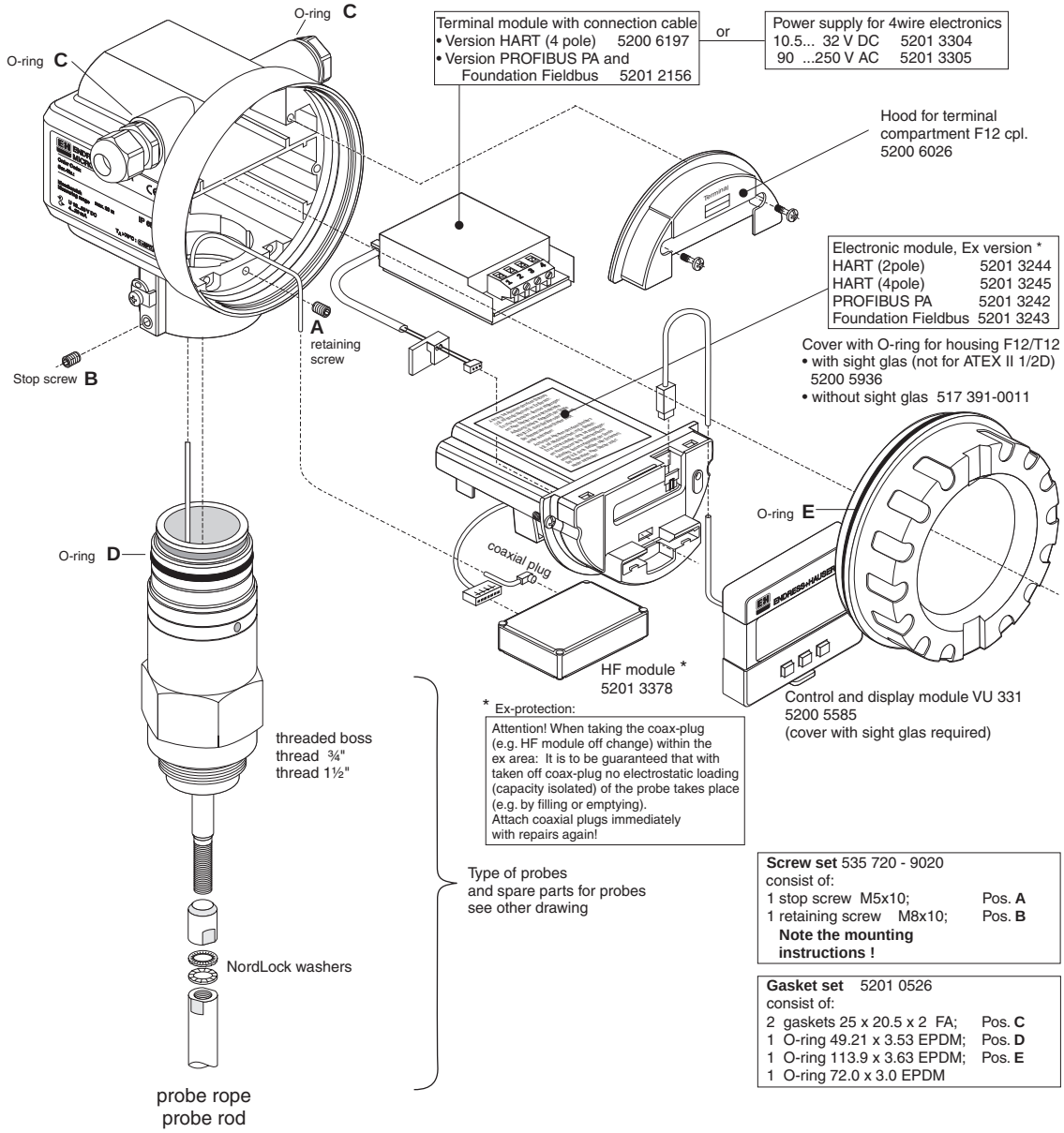
Spare parts Levelflex M FMP 40 with housing F12

Only identical, original E+H spare parts may be used.
The instrument may only be maintained and repaired by qualified personnel. The device documentation, applicable standards and legal requirements as well as any certificates have to be observed!

Housing F12: standard, complete pre-mounted, incl. nameplate, cable gland and Teflon filter

543 120 - 0022	G ½" cable gland
543 120 - 0023	NPT ½" cable gland
543 120 - 0024	M20 x 1.5 PA cable gland
5201 3409	M20 x 1.5 metal cable gland (not for lid with sight glas)
5200 1992	M12 PROFIBUS PA plug
5200 8556	7/8 UNC Fieldbus Foundation plug
5201 3348	G ½" cable gland, 4 wire
5201 3349	NPT ½" cable gland, 4 wire
5201 3350	4 wire, M20 x 1.5 PA cable gland
5201 3351	4 wire, M20 x 1.5 metal cable gland (not for lid with sight glas)

The spare parts listed are generally suitable for use in Ex-devices



* Ex-protection:
Attention! When taking the coax-plug (e.g. HF module off change) within the ex area: It is to be guaranteed that with taken off coax-plug no electrostatic loading (capacity isolated) of the probe takes place (e.g. by filling or emptying).
Attach coaxial plugs immediately with repairs again!

Type of probes and spare parts for probes see other drawing

Screw set 535 720 - 9020
consist of:
1 stop screw M5x10; Pos. **A**
1 retaining screw M8x10; Pos. **B**
Note the mounting instructions !

Gasket set 5201 0526
consist of:
2 gaskets 25 x 20.5 x 2 FA; Pos. **C**
1 O-ring 49.21 x 3.53 EPDM; Pos. **D**
1 O-ring 113.9 x 3.63 EPDM; Pos. **E**
1 O-ring 72.0 x 3.0 EPDM

Spare parts Levelflex M FMP 40 with housing T12

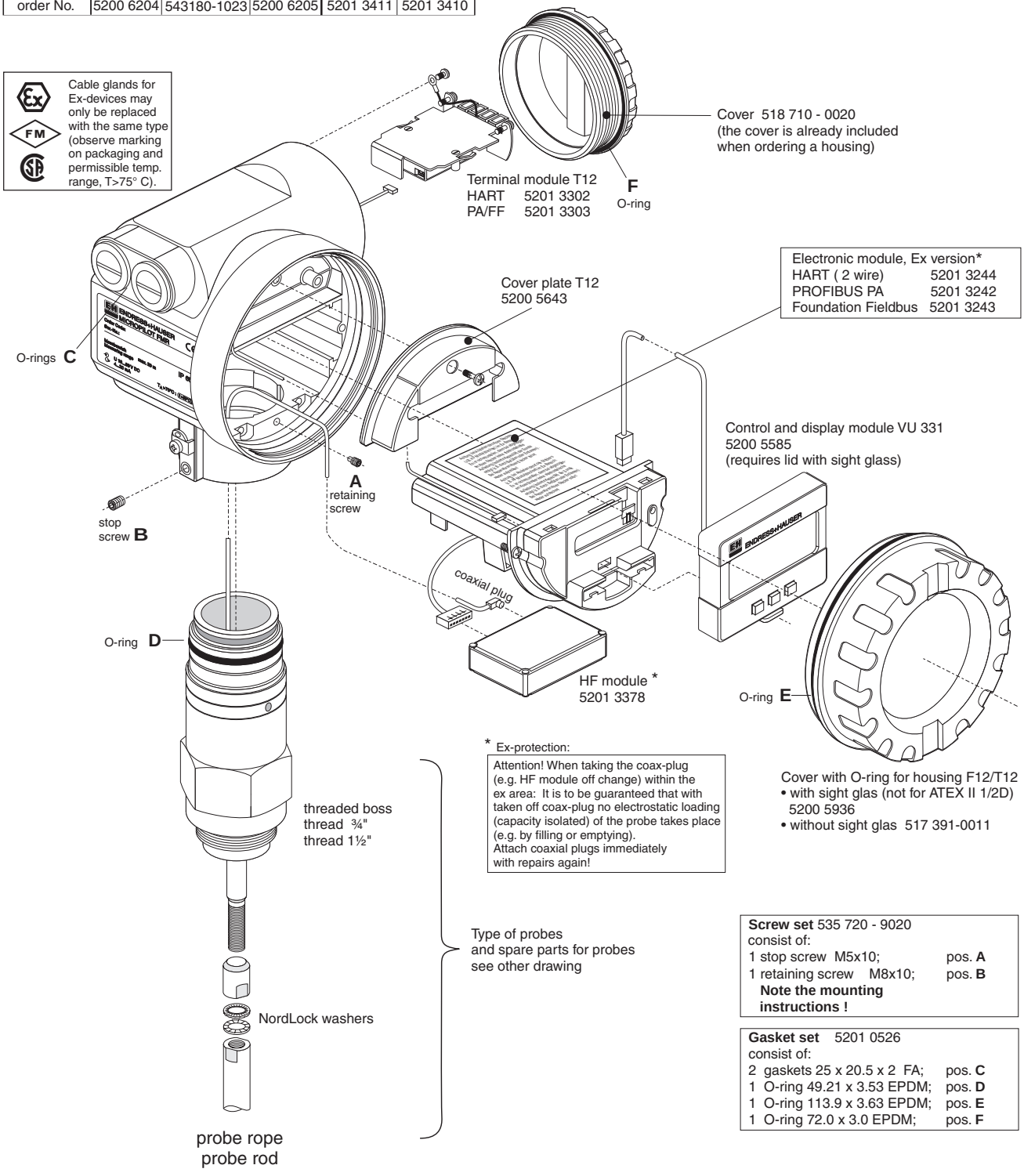
Only identical, original E+H spare parts may be used.
The instrument may only be maintained and repaired by qualified personnel. The device documentation, applicable standards and legal requirements as well as any certificates have to be observed!

Housing T12, complete pre-mounted with lid for terminal compartment

cable gland/ entry	G½	NPT½	M20 x 1.5	only certificates A; F; N plug PROFIBUS	plug Fieldbus FF
order No.	5200 6204	543180-1023	5200 6205	5201 3411	5201 3410

The spare parts listed are generally suitable for use in Ex-devices

Cable glands for Ex-devices may only be replaced with the same type (observe marking on packaging and permissible temp. range, T>75° C).



* Ex-protection:
Attention! When taking the coax-plug (e.g. HF module off change) within the ex area: It is to be guaranteed that with taken off coax-plug no electrostatic loading (capacity isolated) of the probe takes place (e.g. by filling or emptying).
Attach coaxial plugs immediately with repairs again!

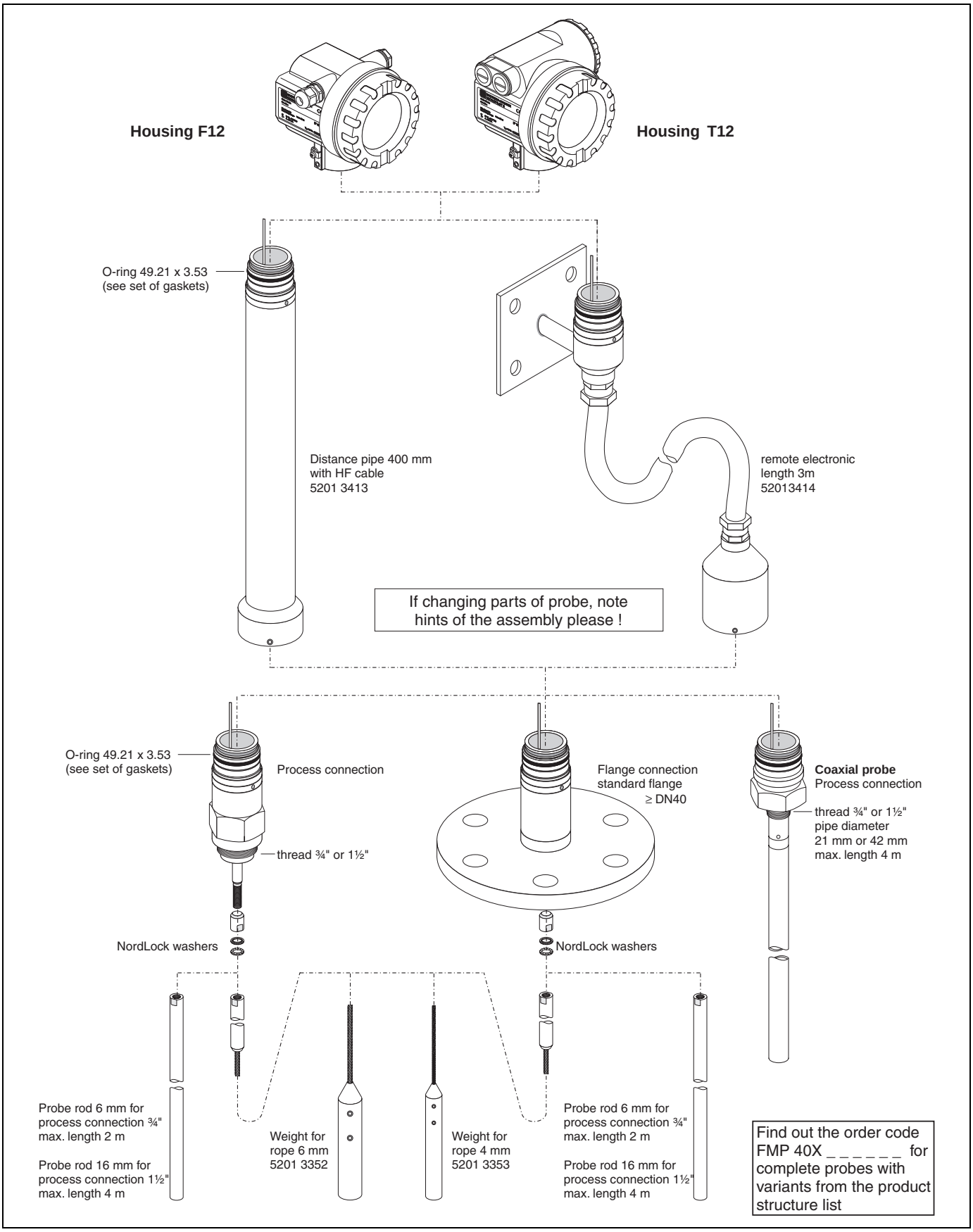
Type of probes and spare parts for probes see other drawing

Cover with O-ring for housing F12/T12
- with sight glas (not for ATEX II 1/2D) 5200 5936
- without sight glas 517 391-0011

Screw set 535 720 - 9020
consist of:
1 stop screw M5x10; pos. **A**
1 retaining screw M8x10; pos. **B**
Note the mounting instructions !

Gasket set 5201 0526
consist of:
2 gaskets 25 x 20.5 x 2 FA; pos. **C**
1 O-ring 49.21 x 3.53 EPDM; pos. **D**
1 O-ring 113.9 x 3.63 EPDM; pos. **E**
1 O-ring 72.0 x 3.0 EPDM; pos. **F**

Spare parts Levelflex M FMP 40 - probes and accessories



9.5 Return

The following procedures must be carried out before a transmitter is sent to Endress+Hauser e.g. for repair or calibration:
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- Always enclose a duly completed "Declaration of contamination" form (a copy of the “Declaration of contamination” is included at the end of this operating manual). Only then can Endress +Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.

Additionally specify:
- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the error that occurred (specify error code if possible)
- If necessary, give the error code.

9.6 Disposal

In case of disposal please seperate the different components according to their material consistence.

9.7 Software history

Software version / Date	Software changes	Documentation changes
V 01.02.00 / 04.2002	Original software. Operated via: – ToF Tool – Commuwin II (from version 2.05.03) – HART communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1.	

9.8 Contact addresses of Endress+Hauser

The addresses of Endress+Hauser are given on the back cover of this operating manual. If you have any questions, please do not hesitate to contact your E+H representative.

10 Technical data

10.1 Technical data at a glance

Application	
Application	The Levelflex M performs continuous level measurement of powdery to granular bulk solids and liquids e.g. plastic granulate. Probes are available with threaded process connections from ¾" and flanges from DN40 / 1½": • Rope probes, above all for measurement in bulk solids, measuring range up to 35 m/1378" • Rod probes, above all for liquids • Coax probes, for liquids
Function and system design	
Measuring principle	The Levelflex is a "downward-looking" measuring system that functions according to the ToF method (ToF = Time of Flight). The distance from the reference point (process connection of the measuring device see page 12) to the product surface is measured. High-frequency pulses are injected to a probe and led along the probe. The pulses are reflected by the product surface, received by the electronic evaluation unit and converted into level information. This method is also known as TDR (Time Domain Reflectometry).
Equipment architecture	see Page 91 ff.
Input	
Measured variable	The measured variable is the distance between the reference point and the product surface. Subject to the input zero point empty distance the level is calculated. Alternatively, the level can be converted by means of linearisation into other variables (volume, mass).
Measuring range	see Technical Information TI 358F
Output	
Output signal	• 4…20 mA with HART protocol
Signal on alarm	Error information can be accessed via the following interfaces: • Local display: – Error symbol (see page 38) – Plain text display • Current output • Digital interface
Auxiliary energy	
Electrical connection	Two housings are available: • Housing F 12 with additionally sealed terminal compartment for standard or EEx ia • Housing T 12 with separate terminal compartment for standard, EEx e or EEx d..
Load HART	Minimum load for HART communication: 250 Ω
Cable entry	see Page 31 ff.
Supply voltage	see Page 31 ff.
Power consumption	min. 60 mW, max. 900 mW

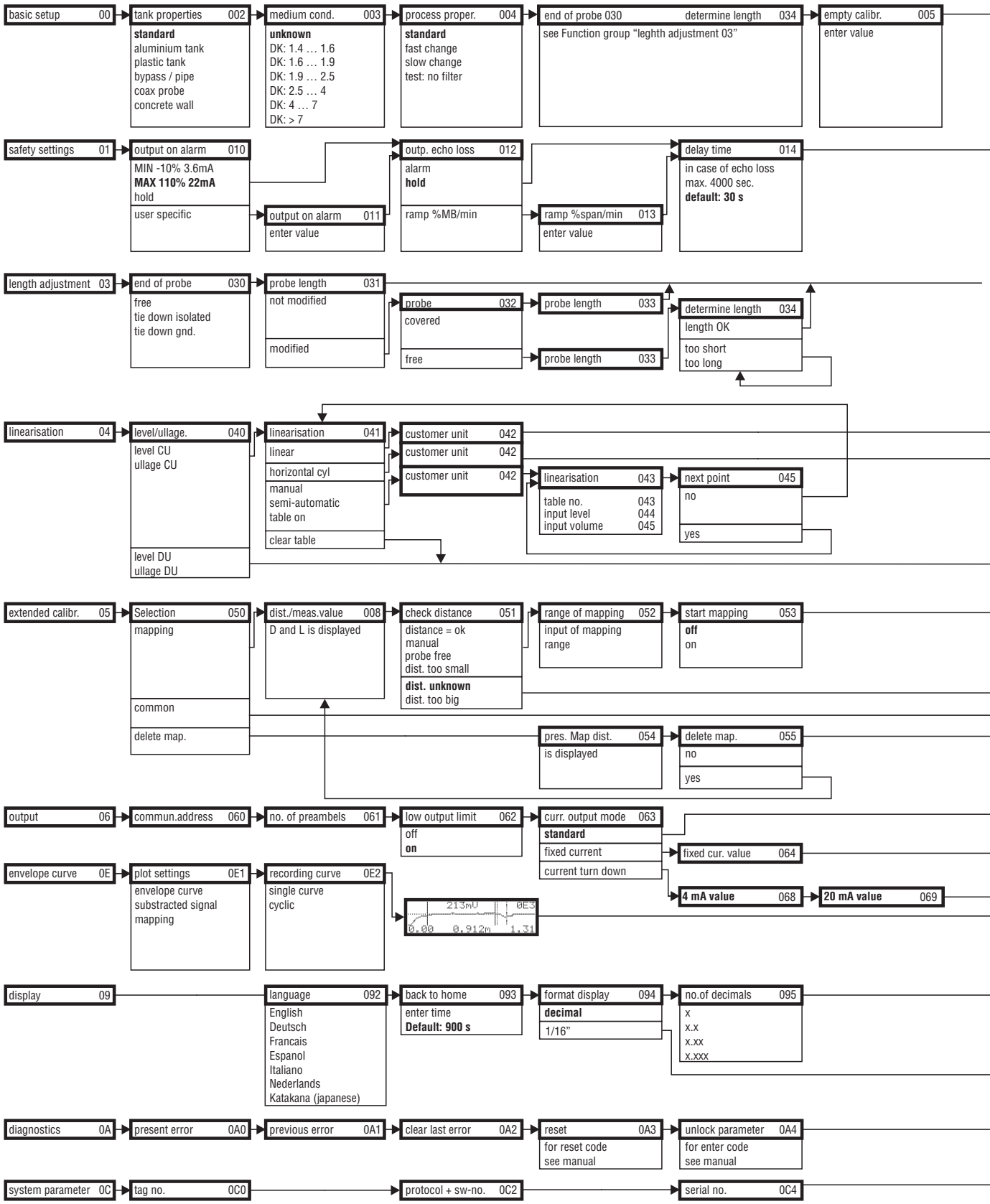
Performance characteristics	
Reference operating conditions	• temperature = +20 °C (68 °F) ±5 °C (9 °F) • pressure = 1013 mbar abs. (14.7 psia) ±20 mbar (0.3 psi) • relative humidity (air) = 65 % ± 20% • Reflection factor 0.8 (surface of water for coax probe, metal plate for rod and rope probe with min. 1 m ∅) • Flange for rod or rope probe ≥ 30 cm ∅ • Distance to obstructions ≥ 1 m
Maximum measured error	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: • Linearity: – up to 10 m/400" measuring range: ±3 mm – 10 m/400" to 35 m/1378" measuring range: ± 0,03 % According to IEC 60770-1
Operating conditions	
Operating conditions	
Installation instructions	see Page 13 ff.
Environment	
Ambient temperature range	The measurements are carried out in accordance with EN 61298-3: • digital output (HART, PROFIBUS PA, Foundation Fieldbus): – **FMP 40** average T_K: 0.6 mm/10 K, max. ± 3.5 mm over the entire temperature range -40 °C...+80 °C **2-wire:** • Current output (additional error, in reference to the span of 16 mA): – **Zero point (4 mA)** average T_K: 0.032 %/10 K, max. 0.35 % over the entire temperature range -40 °C...+80 °C – **Span (20 mA)** average T_K: 0.05 %/10 K, max. 0.5 % over the entire temperature range -40 °C...+80 °C **4-wire:** • Current output (additional error, in reference to the span of 16 mA): – **Zero point (4 mA)** average T_K: 0.02 %/10 K, max. 0.29 % over the entire temperature range -40 °C...+80 °C – **Span (20 mA)** average T_K: 0.06 %/10 K, max. 0.89 % over the entire temperature range -40 °C...+80 °C
Storage temperature	-40 °C ... +80 °C
Climate class	DIN EN 60068-2-38 (test Z/AD)
Degree of protection	• housing: IP 68, NEMA 4X (open housing: IP20, NEMA 1) • probe: IP 68 (NEMA 6P)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20…2000 Hz, 1 $(m/s^2)^2/Hz$
Cleaning of the probe	see Technical Information TI 358F

Electromagnetic compatibility	When installing the probes in metal and concrete tanks and when using a coax probe: • Interference Emission to EN 61326, Electrical Equipment Class B • Interference Immunity to EN 61326, Annex A (Industrial) When rod and rope probes are installed in plastic and wood silos, the influence of strong electromagnetic fields can have an effect on the measured value. Interference Emission to EN 61326 is in this case: Class A.
Process conditions	
Process temperature range	see Technical Information TI 358F
Process temperature limits	see Technical Information TI 358F
Process pressure limits	see Technical Information TI 358F
Dielectric constant	• with coax probe: $\varepsilon r \geq 1,4$ • Rod and rope probe: $\varepsilon r \geq 1,6$
Mechanical construction	
Design, dimensions	see page 12
Weight	see Technical Information TI 358F
Material	see Technical Information TI 358F
Process connection	see Technical Information TI 358F
Human interface	
Operation concept	see page 35
Display	see page 35
Certificates and approvals	
CE approval	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.
External standards and guidelines	**EN 60529** Protection class of housing (IP-code) **EN 61010** Safety regulations for electrical devices for measurement, control, regulation and laboratory use. **EN 61326** Emissions (equipment class B), compatibility (appendix A – industrial area) **NAMUR** Standards committee for measurement and control in the chemical industry
Ex approval	see »Ordering structure Levelflex M FMP 40« on page 6
Ordering Information	
	The E+H service organisation can provide detailed ordering information an information on the order codes on request.
Accessories	
	see page 67

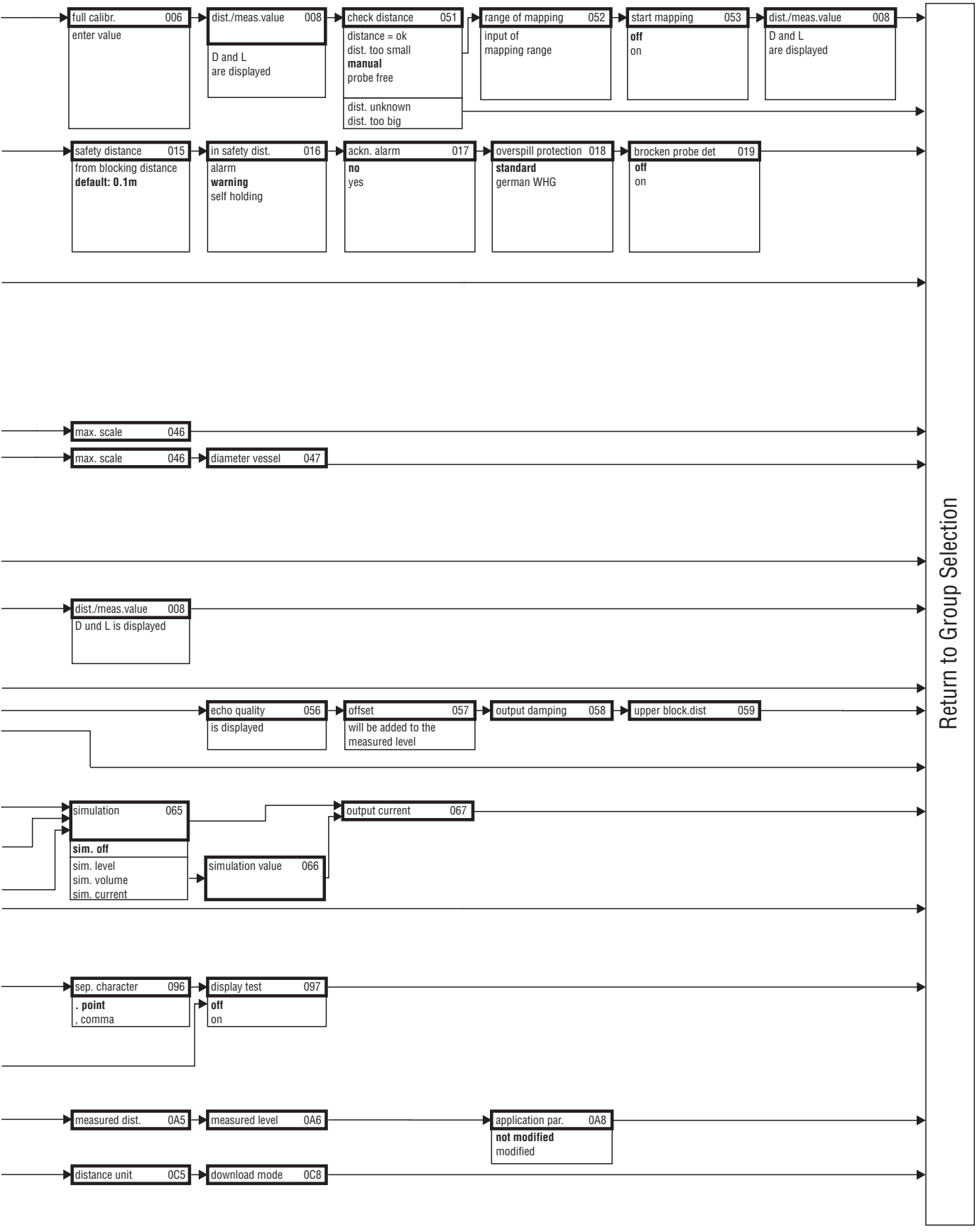
Supplementary Documentation	
Supplementary Documentation	• System Information Levelflex (SI 030F/00/en) • Technical Information (TI 358F/00/en) • Operating Instructions "Description of instrument functions" (BA 245F/00/en)

11 Appendix

11.1 Operating menu HART (Display modul), ToF Tool



Note! The default values of the parameters are typed in boldface.


full calibr. 006
enter value
dist./meas.value 008
D and L
are displayed
check distance 051
distance = ok
dist. too small
manual
probe free
dist. unknown
dist. too big
range of mapping 052
input of
mapping range
start mapping 053
off
on
dist./meas.value 008
D and L
are displayed
safety distance 015
from blocking distance
default: 0.1m
in safety dist. 016
alarm
warning
self holding
ackn. alarm 017
no
yes
overspill protection 018
standard
german WHG
brocken probe det 019
off
on
max. scale 046
max. scale 046
diameter vessel 047
dist./meas.value 008
D und L is displayed
echo quality 056
is displayed
offset 057
will be added to the
measured level
output damping 058
upper block.dist 059
simulation 065
sim. off
sim. level
sim. volume
sim. current
simulation value 066
output current 067
sep. character 096
. point
, comma
display test 097
off
on
measured dist. 0A5
measured level 0A6
application par. 0A8
not modified
modified
distance unit 0C5
download mode 0C8
Return to Group Selection

11.2 Operating matrix HART / Commuwin II

Matrix Mapping *for* **FMP4x - HART**

Function Group	G-EP	V-CWII	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
basic setup	G0	V0	**measured value** CU		**tank properties** **0:standard** 1:aluminium tank 2:plastic tank 3:bypass / pipe 4:coax probe 5:concrete wall	**medium cond.** **0: unknown** 1:1.4 ... 1.6 2:1.6 ... 1.9 3:1.9 ... 2.5 4:2.5 ... 4.0 5:4.0 ... 7.0 6:> 7.0	**process proper.** **0: standard** 1: fast change 2: slow change 3: test:no filter	**empty calibr.** Min: --> 0,0m, ..ft, ..in, ..mm Max: --> 100m ..ft, ..in, ..mm DU **10m, ..ft, ..in, ..mm**	**full calibr.** Min: --> 0,0m, ..ft, ..in, ..mm Max: --> 100m, ..ft, ..in, ..mm DU **10m, ..ft, ..in, ..mm**			
safety settings	G1	V1	**output on alarm** 0:MIN –10% 3.6mA **1:MAX 110%22mA** 2:hold 3:user specific	**output on alarm** Min: --> 3,6 Max: --> 22 mA	**outp. echo loss** 0:alarm **1:hold** 2:ramp %/min	**ramp %span/min** Min: --> -99999 Max: --> 99999 %/min **0**	**delay time** Min: --> 0 Max: --> 4000 s **30**	**safety distance** Min: --> neg. 100m, neg. ..ft, neg. ..In, neg. ..mm Max: --> 100m, ..ft, ..in, ..mm DU **0.1m**	**in safety dist.** 0:alarm **1:warning** 2:self holding	**ackn. Alarm** **0:no** 1:yes	**overspill protection** **0:standard** 1:german WHG	**broken probe det** **0:off** 1:on
length adjustment	G3	V2	**end of probe** **0:free** 1:tie down isolated 2:tie down gnd.	**probe length** **0:not modified** 1:modified	**probe** 0:covered **1:free**	**probe length** Min: --> 0,0m, ..ft, ..in, ..mm Max: --> 15/35/60m, ..ft, ..in, ..mm DU factory calibrated	**determine length** **0:length ok** 1:too short 2:too long					
linearisation	G4	V3	**level/ullage** **0:level CU** 1:level DU 2:ullage CU 3:ullage DU	**linearisation** **0:linear** 1:horizontal cyl 2:manual 3:semi-automatic 4:table on 5:clear table	**customer unit** **0:%,** 1:l, 2:hl, 3:m^3, 4:dm^3 5:cm^3, 6:ft^3, 7:us_gal 8:i_gal, 9:kg, 10:t 11:lb, 12:ton, 13:m 14:ft,15:mm, 16:inch	**table no.** Min: --> 1 Max: --> 32 **1**	**input level** Min: --> 0,0m, ..ft, ..in, ..mm Max: --> 100m, ..ft, ..in, ..mm DU **0,0m, ..ft, ..in, ..mm**	**input volume** Min: --> -99999 Max: --> 99999 CU **0**	**max. scale** Min: --> -99999 Max: --> 99999 CU **100**	**diameter vessel** Min: --> 0,0m, ..ft, ..in, ..mm Max: --> 100m, ..ft, ..in, ..mm DU **9,0m, 29,528ft, 354,331in, 9000mm**		
extended calibr.	G5	V4		**check distance** 0:distance = ok 1:dist.too small 2:dist. too big 3:dist. unknown **4:manual** 5:probe free	**range of mapping** Min: --> 0,3m, ..ft, ..in, ..mm Max: --> 15/35/60m, ..ft, ..in, ..mm **0.3m, 0.984ft, 11.811in,300mm**	**start mapping** **0:off** 1:on	**pres. Map dist** Min: --> - Max: --> - DU	**delete map.** **0:no** 1:yes	**echo quality** Min: --> - Max: --> - mV	**offset** Min: --> neg. 100m, neg..ft, neg...in, neg...mm Max: --> 100m, ...ft, ...in, ...mm DU **0.0 m**	**output damping** Min: --> 0 Max: --> 255 s **3s**	**upper block.dist** Min: --> 0,0m, ...ft, ...in, ...mm Max: --> 15/35/60m ,...ft, ...in, ...mm DU **probe specific**
output	G6	V5	**commun. Address** Min: --> 0 Max: --> 15 **0**	**no. of preambels** Min: --> 4 Max: --> 20 **5**	**low output limit** 0:off **1:on**	**curr.output mode** **0:standard** 1:current turn down 2:fixed current	**fixed cur. Value** **4.0 mA** Min: --> 3,8mA Max: --> 20.5mA mA	**simulation** **0:sim. off** 1:sim. level 2:sim. volume 3:sim. current	**simulation value** Min: --> 3.6 mA Max: --> 22.0 mA or Min: --> -2,0m, -6,562ft, -78,740in, -2000mm Max: --> 100m, ..ft, ..in, ..mm	**output current** mA	**4mA value** Min: --> -99999 Max: --> 99999 CU **0**	**20mA value** Min: --> -99999 Max: --> 99999 CU **100**
display	G9	V6			**language** **0:English** 1:German 2:Français 3:Español 4:Italiano 5:Nederlands	**back to home** Min: --> 3 Max: --> 9999 s **900**	**format display** **0:decimal** 1:1/16"	**no.of decimals** 0:x 1:x.x **2:x.xx** 3:x.xxx	**sep. character** **0: .** 1: ,			
service	GD	V7										
self check	GB	V8										
diagnostics	GA	V9	**present error**	**previous error**	**clear last error** **0:keep** 1:erase	**reset** Min: --> 0 Max: --> 65535	**unlock parameter** Min: --> 0 Max: --> 33997 **HART: 100** **PA/FF : 2457**	**measured dist.** DU	**measured level** DU		**application par.** 0:not modified 1:modified	
system parameter	GC	VA	**tag no.**		**protocol+sw-no.** xx.yy.zz.prot xx: HW- Version yy: SW- Version zz: SW-Version prot: protocol name		**serial no.**	**distance unit** **0:m** 1:ft 2:mm 3:inch			**download mode** **0:parameter only** 1:param+cust.map 2:only mapping	

Note!
In brackets ( ) you can see the maximum value, which can be edit.

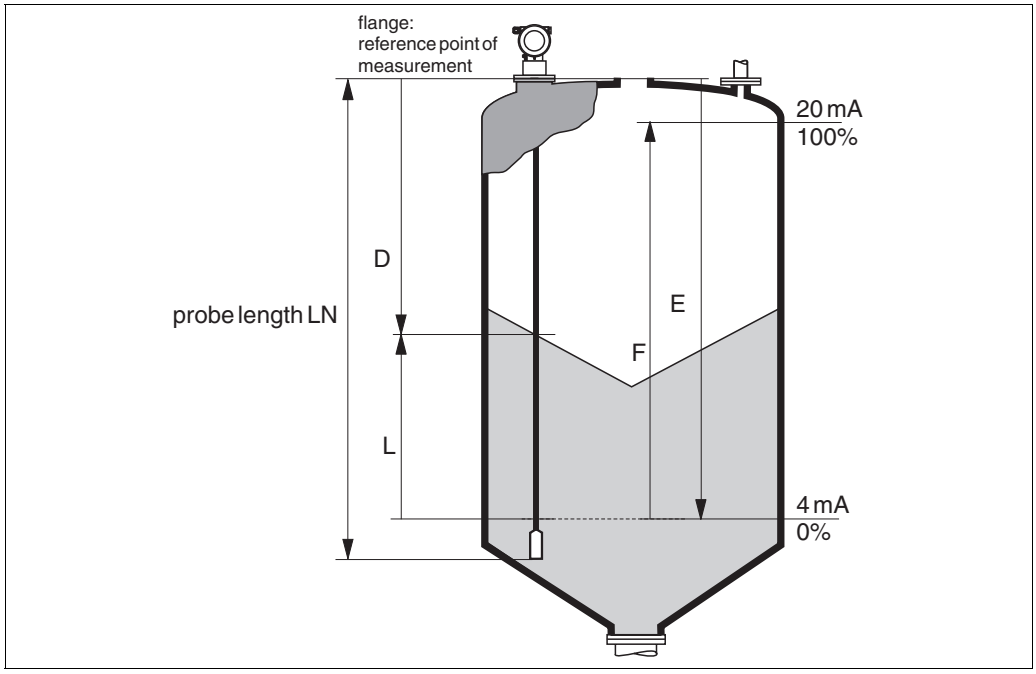
11.3 Description of functions

Note!
A detailed description of the function groups, functions and parameters is given in the documentation BA 245F/00/en - a description of the instrument functions of the Levelflex M.

11.4 Function and system design

11.4.1 Measuring principle

The Levelflex is a "downward-looking" measuring system that functions according to the ToF method (ToF = Time of Flight). The distance from the reference point (process connection of the measuring device see page 12) to the product surface is measured. High-frequency pulses are injected to a probe and led along the probe. The pulses are reflected by the product surface, received by the electronic evaluation unit and converted into level information.
This method is also known as TDR (Time Domain Reflectometry).



Input
The reflected pulses are transmitted from the probe to the electronics. There, a microprocessor analyses the signals and identifies the level echo, which was generated by the reflection of the high-frequency pulses at the product surface. This clear signal finding benefits from the many years experience with pulse time-of-flight procedures that have been integrated into the development of the PulseMaster® Software.
The distance D to the product surface is proportional to the time of flight t of the impulse:

$D = c \cdot t/2$,
with c being the speed of light.

Based on the known empty distance E, the level L is calculated:

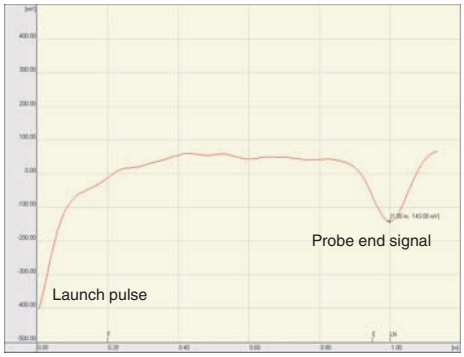
$L = E - D$

Reference point for "E" see above diagram, Details see page 47.
The Levelflex possesses functions for the interference echo suppression that can be activated by the user. They guarantee that interference echoes from e.g. internals and struts are not interpreted as level echoes.

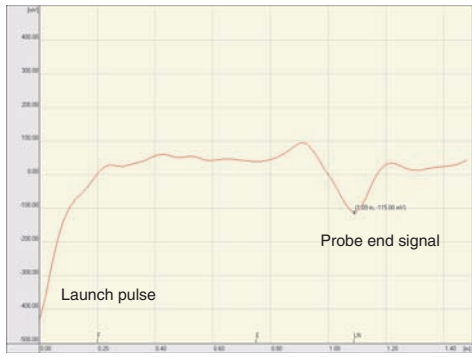
Output
The Levelflex is initially adjusted at the factory to the probe length ordered, so that in most cases only the application parameters, that automatically adapt the device to the measuring conditions, need to be entered. For models with current output, the factory adjustment for zero point and span is F 4 mA and 20 mA, for digital outputs and the display module 0 % and 100 %.
A linearisation function with max. 32 points, that is based on a manually or semi-automatically input table, can be activated on-site or via remote operation. This function enables, for example, the conversion of the level into units of volume or weight.

An evaluation of the measurement with the aid of the envelope curve

Typical curve shape
The following examples display typical curve shapes for a rope or rod probe in an empty tank. For all probe types, a negative probe end signal is shown. For rope probes, the end weight causes an additional preliminary positive echo (see rope probe diagram).



Rod probe

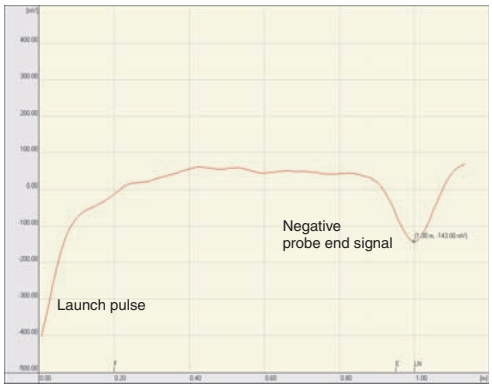


Rope probe

Level echoes are detected as positive signals in the envelope curve. Interference echoes can be both positive (e.g. reflections from internals) and negative (e.g. nozzles). The envelope curve, the map and the differential curve are used for the evaluation. Level echoes are searched for in the differential curve.

Evaluation of the measurement:

- The map must correspond to the course of the envelope curve (for rod probes up to approx. 5 cm and for rope probes up to approx. 25 cm before the end of the probe) when the tank is empty.
- Amplitudes in the differential curve should be at a level of 0 mV when the tank is empty and lie within the span that is specified by the probe-specific blocking distances. In order to not detect any interference echoes, there must be no signals that exceed the echo threshold when the tank is empty.
- For partially-filled tanks, the map may only differ from the envelope curve at the position of the level echo. The level signal is then detected unequivocally as a positive signal in the differential curve. For detecting the level echo, the amplitude must lie above the echo threshold.



Envelope curve

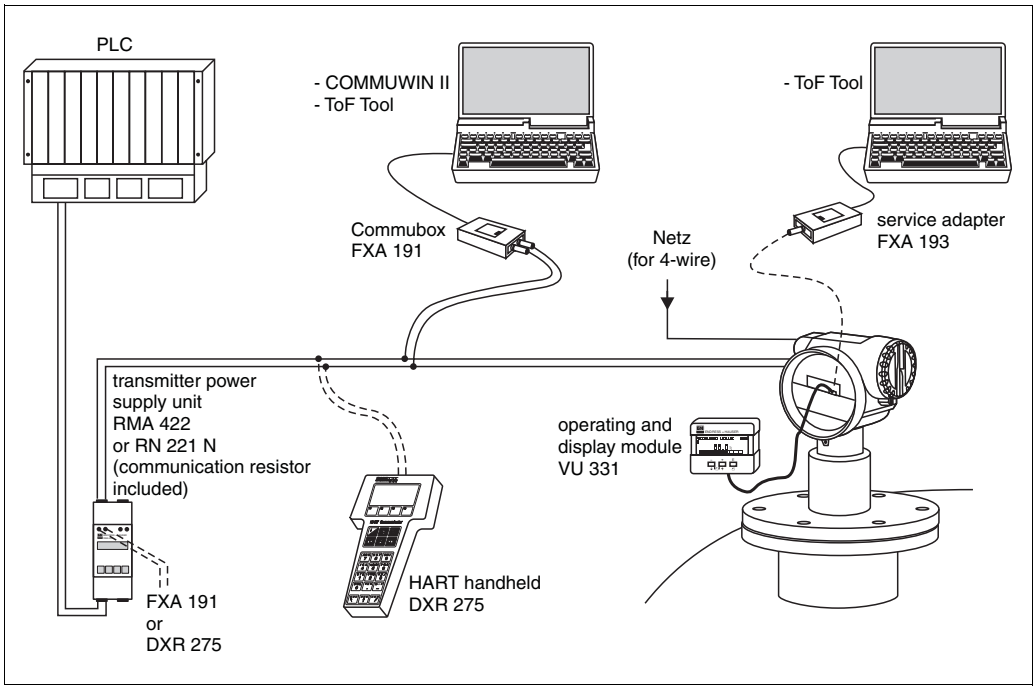
Mapping

Differential curve = Envelope curve Mapping

11.4.2 Equipment architecture

Stand-alone

- Power supply directly from power line (4-wire) or from transmitter power supply unit (2-wire).
- Operation by on-site display or remote operation via HART protocol.



If the HART communication resistor is not installed in the supply device and HART protocol communication is to be carried out, it is necessary to insert a $\geq$ 250 Ω communication resistor into the 2-wire line.

This product may be protected by at least one of the following patents.
Further patents are pending.

- US 5,345,471 ≙ EP 0 694 235 (under Licence)
- US 5,517,198 (under Licence)
- US 5,661,251 ≙ EP 0 780 664
- US 5,827,985 ≙ EP 0 780 664
- US 5,884,231 ≙ EP 0 780 665
- US 5,973,637 ≙ EP 0 928 974

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Customer contact:
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